Air Traffic Services

CONCEPT OF OPERATIONS

for the National Airspace System in 2005

OPERATIONAL TASKS & SCENARIOS

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DRAFT

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Acronym List

TBD

INTRODUCTION

A Concept of Operations for the National Airspace System in 2005 consists of two documents. The first, *Narrative*, provides a high-level description of system capabilities. This document, *Operational Tasks & Scenarios*, furnishes a detailed view of those capabilities by describing the tasks required to provide operational services in four areas. These 'service areas' are 1) Air Traffic Control Services, 2) Traffic Management Services, 3) Flight Advisory Services, and 4) Infrastructure Management Services.

This document, along with information from the National Airspace Review and other sources, will be used as a reference source by 1) the Air Traffic Service (ATS) to define operational needs and responsibilities, 2) the Air Traffic Requirements Service to define requirements and influence investment decisions, and 3) the Systems Architecture Group to define hardware/software solutions. To assist these Services, this document describes commonly occurring task activities within each service area.[1] It then provides a number of operational scenarios to illustrate system capabilities and service provider activities in various situations. The task descriptions are presented in the form of 'task modules' for each task category within each service area. The operational scenarios are presented in narrative form. The document is comprised of five Sections:

- Section A, Air Traffic Control Services.
- Section B, Traffic Management Services.
- Section C, Flight Advisory Services.
- Section D, Infrastructure Management Services.
- Section E, Operational Scenarios.

Document Structure & Nomenclature

As a reference source for system developers, this document makes no recommendations regarding hardware/software solutions, the number or types of facilities in 2005, or the hybridization of today's domains. However, today's system *is* used as a point of departure for defining operational tasking of 2005. A basic characteristic of today's system is its division into the domains of En Route, Approach Control, Tower, and Flight Service. While these domains provide the basis for categorizing service provider tasks, this document is structured to leave ATS free to optimize the allocation of those tasks to new types of facilities and domains in 2005. This approach is accomplished by referring to *service areas* and *task modules*, rather than to *domains* or *specialties*. Using this approach, the four service areas comprise a total of 15 task modules, as follows:

- Section A — Air Traffic Control (ATC) Services
  - Part 1 — En Route Control (ECON) task module.
  - Part 2 — Arrival/Departure Control (ADCON) task module.
  - Part 3 — Surface Control (SCON) task module.
  - Part 4 — Oceanic Control (OCON) task module.
- Section B — Traffic Management (TM) Services
  - Part 1 — En Route Traffic Management task module.
  - Part 2 — Arrival/Departure Traffic Management task module.
  - Part 3 — Surface Traffic Management task module.
  - Part 4 — Oceanic Traffic Management task module.
  - Part 4 — National Traffic Management task module.
- Section C — Flight Advisory Services (FAS)
  - Part 1 — Pre-flight Advisory task module.
  - Part 2 — In-flight Advisory task module.
  - Part 3 — Emergency Advisory task module.
  - Part 4 — External Support task module.

[1] This draft of *Operational Tasks & Scenarios* presents En Route and Arrival/Departure control task descriptions, and several scenarios. Subsequent drafts will describe Flight Planning, Surface Control, Traffic Flow Management, and Oceanic Operations.

Part 5 — ATS Support task module.

- Section D — Infrastructure Management (IM) Services
  Part 1 — System Operations Center (SOC) task module.
  Part 2 — Work Center (WC) task module.

For descriptive convenience, this document refers to service providers by titles that assume they perform *only* the tasks within the task module under discussion. Under this convention, ATC services are provided by 'controllers,' TM services are provided by 'traffic managers,' FAS services are provided by 'advisors,' and IM services are provided by 'infrastructure managers.' However, the task modules do not necessarily represent areas of service provider specialization. Thus, in the terminology of this document, an 'ECON controller' is not one who works in an ECON *facility*, but is one who performs ECON *tasks*. This convention eliminates constraints on the allocation of tasks across a wide range of options. For example, the need may eventually be defined for separate ECON, ADCON, and FAS facilities in some cases, while in other cases these task types may be consolidated within a facility. In such a consolidated facility, a controller performing ADCON tasks may work at a control room position that is flanked by an ECON sector on one side, and by a FAS position on the other. Tasks may also be combined at the operational position level, so that, for example, a single service provider might perform selected ECON, ADCON, and FAS tasks in accordance with the defined responsibilities of that position.

Task Description Format

The task modules presented in this document capture the major automation/service-provider interactions that comprise the bulk of the service provider's work. Two general types of tasks are not addressed in the modules. These are 1) atypical tasks that do not reflect widely-used system functions,[2] and 2) commonly occurring tasks that will be performed as they are today, with no effect on automation.[3] Thus the absence of a task in a module does not indicate that it is no longer performed in 2005, but rather that the task is not relevant to this document's descriptive purpose. All task descriptions follow the same general format, with each description consisting of several elements. Some of these elements vary slightly within different modules due to subject matter content. However, the format is adequately illustrated by the Air Traffic Control task descriptions, which consist of the following elements:

- Task Objective — The desired operational result of the task.
- Background — A general discussion on information sources and operational applications.
- Responsibility — An allocation of task responsibility among service providers and automation.
- Information — The operational information that is required to perform the task. Each task description lists the information that is of greatest utility in regard to the task under discussion.[4] These listings represent the global information requirements at all types of sectors in the performance of the task. At the sector-specific level, that global set can be filtered based on the sector's operational objectives. This filtering, referred to as 'sector definition,' is set in automation for each position based on national, regional, or facility criteria (as opposed to controller-preference selectability). Each task's information outputs are categorized as follows:
  - 'Automatically Displayed:' Sector defined information the system displays without any controller action required.
  - 'On-Request:' Sector defined information that is easily available, based on a manual request action.
  - 'Automatically Displayed or On-Request:' Information that is easily available, and can be output in either manner depending upon sector definition.
  - 'Forced:' Specific data that the controller at one sector causes to be displayed at another sector, regardless of the data formats or filters in use at the receiving sector.

[2] Manual control activities are an example of 'atypical' tasks in the 2005 control environment.
[3] The communications transfer for non-datalink-equipped flights is unchanged from current practices, and is therefore not addressed.
[4] The entire set of NAS information is available at all positions, based on security and access requirements. However, the system provides the easiest access to information that is required for specific task performance.

NAS Components in 2005

Inputs and Displays. The input language provides maximum ease and quickness. The major displays include the situation display, Flight Information Postings (FIPs) which output flight-specific information from all sources, and displays of non-flight-specific data. These displays also provide a graphical user interface with the input language for the most frequently used input message types.

Datalink. Digitized communications are provided between the aircraft and all operational positions that are providing control, traffic management, or advisory services to the flight. Only one ATC sector at a time is in datalink communications with the flight, and all positions in communications with that flight are limited by defined message type eligibility. Datalink clearances and pilot-initiated messages are displayed in flight-specific data objects within the situation display and the FIPs, as appropriate.

Conflict Probe And Trial Planning. These tools identify conflicts with airspace, terrain, weather, and aircraft. They utilize precise trajectory modeling that is based on enhanced aircraft status and performance data, detailed wind and weather information, procedural sector requirements, traffic management restrictions, and user preference and pilot intent information.

Dynamic Density Measurements and Predictions (En Route Only). The system measures and predicts dynamic density at all En Route sectors. The data for each sector is output at that sector. Data for *all* sectors is available to supervisors and traffic managers.

Traffic Management Tools. General traffic management initiatives define requirements for all flights within major traffic flows. These requirements may be static (i.e., permanent) restrictions. More typically, they are flight-specific advisories that are dynamically generated by TM decision support systems.

Weather Display and Analysis. Detailed weather information is selectively presented on sector displays, and is available on the flight deck via the NAS-Wide Information System (NAS-WIS). Some of this information is transmitted from aircraft. Flight-specific weather probe data for weather avoidance advisories is output at the relevant operational positions.

Special Use Airspace (SUA) Status And Planning. SUA status is selectively output to controllers, supervisors, and traffic managers via the NAS-WIS. SUA schedules are output on request. An SUA probe continually checks each flight across the length of its route.

Dynamic Airspace Configuration. Current sector combinations and boundary configurations are depicted on the displays at all relevant operational positions. Planned combinations and configurations are available to the supervisor, the TM, and, for infrastructure management, to the SOC. These tools enhance the current flexibility of ADCON airspace, and bring that level of flexibility to the ECON environment as well.

Pilot Self-Separation. Real time traffic information on the flight deck allows responsibility for separation to be delegated to the pilot under certain conditions. These conditions include overtake situations, departures climbing to altitude, and sequencing, spacing, and/or stationkeeping within a traffic flow.

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SECTION A — AIR TRAFFIC CONTROL SERVICES

This Section of *Operational Tasks & Scenarios* presents a conceptual description of the En Route, Arrival/Departure, Surface, and Oceanic control environments. The four Parts of this Section illustrate the detailed effects of enhanced automation on controller tasking as follows:

- Part 1, En Route Control (ECON) Task Module (page 11).
- Part 2, Arrival/Departure Control (ADCON) Task Module (page 27).
- Part 3, Surface Control (SCON) Task Module (TBD).
- Part 4, Oceanic Control (OCON) Task Module (TBD).

Operational Overview

The concepts presented here are derived from extensive discussions with numerous air traffic controllers, supervisors, and traffic managers from terminal and en route facilities. Those discussions allow the following conclusions to be drawn concerning system operation and the controller's role in 2005:

System Operation. In 2005, the NAS serves heavier traffic demand while also increasing safety. New tools enable users to determine the most advantageous flight trajectories, and allow controllers to accommodate them. Since increased demand and user flexibility result in greater complexity, decision support systems (DSSs) assist controllers and pilots in preventing conflicts with airspace, weather, terrain, and other aircraft.

Role of the Controller. As a step toward an end-state environment, automation in 2005 provides more assistance than the current system in task performance and decision-making. But while these system functions create changes in their thought processes and manual tasking, controllers continue their role as fully-engaged decision-makers. Because of these task performance and decision-making aids, controllers are able to handle more traffic without incurring additional workload, as follows:

- Task Performance. Improved inputs and displays assist the controller in the performance of manual tasks (e.g., computer inputs, and interphone and radio communications). The resulting reduction in tasktime per airplane increases the number of airplanes the controller has time to handle, by increasing the number of coordination and clearance transactions that can be implemented per unit time.

- Decision-making. While task-performance aids increase the number of decisions controllers can *implement*, DSSs provide cognitive assistance that increases the number of decisions controllers can *make*. Today, controllers mentally model every flight under their control. This mental analysis of all flights is made more difficult by the increased traffic volume and complexity in 2005. Thus DSSs indicate flights and situations that require the controllers' fullest attention, and, by the absence of such alerts, indicate the flights that do not require detailed attention.

Controller Tasking

The ATC Services task modules assume an automation environment comprised of *task-performance aids* that assist in the execution of manual tasks, and *decision support systems* that provide cognitive assistance. Together, these aids and systems generate a far greater increase in traffic capacity than either type of aid produces individually.

Task Performance Aids. The objectives of manual task assistance are to 1) minimize the time required to make computer inputs, 2) allow the use of computer inputs and outputs in place of radio and interphone communications, and 3) provide support in identifying time-critical tasking. To meet these objectives, most NAS components that interface with the controller are operated through common input devices and message structures, and all flight-specific data are output on integrated displays. As a result, assistance is provided by an input and display language that simplifies the use of NAS components, provides system assisted (i.e. 'silent') coordination, and brings time-critical tasking to the controller's attention, as follows:

- Controller Inputs — The input language provides two types of assistance. First, it slaves NAS inputs, such as speeds and headings, to other systems such as datalink. Thus a NAS input updates the flight object and the sector displays, and also triggers the operation of the slaved system. In the case of datalink, the system automatically composes a textual clearance based on the message type and data content of the NAS message. The composed message is presented to the controller for review (and editing, if required), and then uplinked via manual "transmit" action by the controller. By simplifying the use of datalink, this NAS/datalink interface enables digital communications with flights even in fast-paced tactical situations.

The second type of system assistance provides message-content options based on sector adaptation, and upon the output of the various system components. For example, the Assigned Altitude function for a flight may contain a value based on an LOA restriction, a value preplanned by the controller, and three values proposed by the conflict resolution function. All of these options are openly displayed within that flight's data objects, in the form of pre-loaded input selection options. The activation of any of the input selection options will compose and execute the computer message for that flight.

- Silent Coordination — Inter-sector voice communications are reduced through the use of computer inputs and display outputs to perform silent coordination. This includes control negotiations on handoff, pointouts and APREQs, and the forwarding of control information. The display language also provides sector-defined or on-request data describing the role of all sectors in the handling of the flight. This data includes the sector in possession of the track, the sector in communications with the flight, the level of control exercised by one sector while the flight is in another sector's airspace, preplanned actions by the controlling sector, and the identities of all sectors observing the flight.
- Task Prompts — High traffic volume in 2005 increases the difficulty of tracking the task status of each flight. The system therefore provides prompts for tasks that are both predictably required and objectively time-constrained. These alerts include an indicator of the boundary penetration avoidance point on handoff, a communications-transfer indicator for a handed-off flight approaching the boundary, an indicator for unacknowledged datalink clearances, and an indicator for procedural control actions such as an LOA-required descent. Timing indicators are also available for objectively time-constrained DSS control-action advisories.

Decision Support. With tasktime per flight greatly reduced, controllers have time to handle more flights than they can conveniently analyze. DSSs therefore assist controllers in their analysis by detecting problems and providing resolution options. For example, when a probe alerts controllers to conflicting traffic, they analyze the system-generated resolutions and select the most advantageous option. When flights are not in conflict, but require action to meet operational objectives such as sequencing and spacing, controllers use the trial planning function to test mentally-generated control-action options in order to avoid *putting* the flights into conflict. These automated analyses allow controllers to concentrate on critical traffic interactions, while safely reducing the attention they pay to the balance of the traffic population that is considered problem-free by the system. For those flights, the controller's primary concern is to ensure the timely completion of routine tasks such as handoffs and frequency changes.

To maximize their usage and effectiveness, DSSs are integrated into the system's input and display languages. This expedites the entry of control-action options by displaying system generated resolutions as input selection options. In addition, input options generated from other sources are disabled, or flagged for the controller's attention, if the entry of that value will create a conflict. These other sources include preplanned actions by the controller, sector default values for procedural or LOA requirements, etc.

The following example illustrates the integrated system discussed above — When a conflict is detected for a datalink-equipped flight, the system may generate pre-loaded input selection options for three resolution options. In this example, each option consists of a heading, an altitude, and a pointout to another sector. Single-stroke activation of the selected option updates the heading and altitude on the sector displays, initiates the pointout, and composes a datalink message for the controller's review. Upon receiving silent approval for the pointout via the sector displays, and after reviewing the datalink message, activation of the datalink "transmit" function implements the conflict resolution. The controller's attention then turns to other tasks until acknowledgment of the clearance is received via datalink, and the task cycle is completed. Timing indicators alert the controller to objectively time-constrained actions, such as overdue pointout responses or clearance acknowledgments.

Task Modules

Figure 1 below illustrates the ECON and ADCON task modules.[5] Various terms are used on the task modules to promote the development of seamless operations, and to reflect the technical environment of 2005. For example, today's "Radar Controller" is known as the "Tactical Controller" in 2005, since radar in that time frame is only one of several types of surveillance data. The balance of this paragraph defines the terms used in the task modules that follow.

Sector — An operational volume of En Route or ADCON airspace.

Sector Team — An inclusive term for the controllers operating an ECON sector.

- *Tactical Controller* — The controller responsible for overall traffic handling, and for the conduct of radio communications.
- *Associate Tactical Controller* — The ECON controller responsible for coordination, referred to today in Centers as the associate radar controller, or D-controller. This position is co-located at the sector, with the ability to monitor the radios and with a full set of dedicated input and display devices.
- *Area Coordinator* — An ECON controller who performs intermediate-range planning for one or more sectors within an area of specialization. The duties of the Area Coordinator are midway between those of the Associate Tactical Controller and the TMC.

Tactical Controller(s) — The notation used for the controllers operating an ADCON sector. These sectors are generally operated by one Tactical Controller. When required by traffic and workload considerations, a second Tactical Controller assists in the operation of the sector.

- One Tactical Controller is responsible for overall traffic handling, and for the conduct of all radio communications.
- The second Tactical Controller may be co-located at the sector, with at least a full set of input devices, or non-co-located with a full set of input *and display* devices. The ability to monitor the sector's radios is not mandatory. The position may be staffed by a controller, supervisor, or TM, and it may assist in the operation of one or more sectors.
- The notation 'Tactical Controller(s)' is used if either controller may perform a task. Relatively few tasks must be performed by one controller or the other, and this responsibility allocation is described in the appropriate task descriptions.

Acronyms

CDTI	Cockpit Display of Traffic Information.
DSS	Decision Support System.
FIP	Flight Information Posting.
NAS-WIS	NAS-Wide Information System.
TM	Traffic Management, or Traffic Manager.
TMU	Traffic Management Unit
UOC	User Operations Center (a generic reference to Airline Operations Centers, military operations centers, and private concerns providing similar services to independent operators).

[5] SCON and OCON task modules will be presented in subsequent drafts of this document.

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SECTION A — AIR TRAFFIC CONTROL SERVICES

Part 1 — En Route Task Module

1.0 ECON Situation Awareness

1.1 Maintain Awareness of Environmental Conditions
- 1.1.1 Monitor airport/airspace conditions
- 1.1.2 Assess current and predicted wind/weather
- 1.1.3 Assimilate aeronautical information
- 1.1.4 Assimilate NAS infrastructure status

1.2 Maintain Awareness of Pending Traffic
- 1.2.1 Monitor flight-specific information
- 1.2.2 Monitor non-flight-specific information

1.3 Maintain Awareness of Immediate Traffic
- 1.3.1 Monitor the sector's primary traffic information
- 1.3.2 Receive internal & external interphone calls
- 1.3.4 Receive pilot-initiated datalink messages
- 1.3.5 Receive pilot-initiated radio calls

1.4 Make Control Decisions & Plan Task Priorities
- 1.4.1 Assure air safety
- 1.4.2 Meet procedural requirements
- 1.4.3 Conform to TM initiatives
- 1.4.4 Maximize the use of pilot separation
- 1.4.5 Balance overall delay

2.0 ECON Sector Entry

2.1 Assess the Impact of the Approaching Flight
- 2.1.1 Receive information on the approaching airborne flight
- 2.1.2 Coordinate with an ECON or ADCON sector to resolve conflicts

2.2 Receive the Approaching Flight
- 2.2.1 <u>Either</u> initiate ATC services for a pop-up flight
- 2.2.2 <u>Or</u> receive a flight from another sector
  - (a) Observe handoff notification
  - (b) Plan timely handoff acceptance
  - (c) <u>Either</u> request control & accept/reject handoff
  - (d) <u>Or</u> monitor automatic handoff acceptance
  - (e) Receive initial datalink contact
  - (f) Receive initial radio call

3.0 ECON Sector Transit

3.1 Implement Control Decisions
- 3.1.1 Perform coordination
- 3.1.2 Issue clearances
- 3.1.4 Provide IFR & VFR advisories

3.2 Transfer the Flight to Next Sector
- 3.2.1 Ensure timely handoff initiation
- 3.2.2 Release control to next sector if requested
- 3.2.3 Ensure timely handoff acceptance or rejection
- 3.2.4 Issue communications change
- 3.2.5 Suppress the flight's flight information postings
- 3.2.6 Suppress the flight's data block

Part 2 — Arrival/Departure Task Module

1.0 ADCON Situation Awareness

1.1 Maintain Awareness of Environmental Conditions
- 1.1.1 Monitor airport/airspace conditions
- 1.1.2 Assess current and predicted wind/weather
- 1.1.3 Assimilate aeronautical information
- 1.1.4 Assimilate NAS infrastructure status

1.2 Maintain Awareness of Pending Traffic
- 1.2.1 Monitor flight-specific information
- 1.2.2 Monitor non-flight-specific information

1.3 Maintain Awareness of Immediate Traffic
- 1.3.1 Monitor the sector's primary traffic information
- 1.3.2 Receive internal & external interphone calls
- 1.3.4 Receive pilot-initiated datalink messages
- 1.3.5 Receive pilot-initiated radio calls

1.4 Make Control Decisions & Plan Task Priorities
- 1.4.1 Assure air safety
- 1.4.2 Meet procedural requirements
- 1.4.3 Conform to TM initiatives
- 1.4.4 Maximize the use of pilot separation
- 1.4.5 Balance overall delay

2.0 ADCON Sector Entry

2.1 Assess the Impact of the Approaching Flight
- 2.1.1 Receive information on the approaching flight
  - (a) <u>Either</u> an airport departure
  - (b) <u>Or</u> an airborne flight
- 2.1.2 Coordinate to resolve conflicts
  - (a) <u>Either</u> with the surface controller
  - (b) <u>Or</u> with an ECON or ADCON sector

2.2 Receive the Approaching Flight
- 2.2.1 <u>Either</u> initiate ATC services for a departure or pop-up flight
- 2.2.2 <u>Or</u> receive a flight from another sector
  - (a) Observe handoff notification
  - (b) Plan timely handoff acceptance
  - (c) <u>Either</u> request control & accept/reject handoff
  - (d) <u>Or</u> monitor automatic handoff acceptance
  - (e) Receive initial datalink contact
  - (f) Receive initial radio call

3.0 ADCON Sector Transit

3.1 Implement Control Decisions
- 3.1.1 Perform coordination
- 3.1.2 Issue clearances
- 3.1.4 Provide IFR & VFR advisories

3.2 Transition the Flight Out of the Sector
- 3.2.1 <u>Either</u> transfer flight to the surface controller
- 3.2.2 <u>Or</u> transfer flight to the next sector
  - (a) Ensure timely handoff initiation
  - (b) Release control to next sector if requested
  - (c) Ensure timely handoff acceptance or rejection
  - (d) Issue communications change
  - (e) Suppress the flight's flight information postings
  - (f) Suppress the flight's data block

Section A Parts 1 & 2 Task Modules
Figure 1.

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Part 1 — EN ROUTE CONTROL (ECON) TASK MODULE

This Part describes En Route Control (ECON) tasking in 2005. At a sector dedicated to ECON tasks, the sector team consists of up to three controllers; the Tactical Controller, Associate Tactical Controller, and Area Coordinator. The Tactical Controller and the Associate Tactical Controller are co-located. The Area Coordinator is non-co-located, and may assist in the operation of more than one sector. This module outlines a representative set of tasks under the level of automation envisioned in 2005, as follows: *Overall Situation Awareness Tasks* describe the activities required to remain aware of environmental and traffic conditions, and to make and prioritize control decisions. *Sector Entry Tasks* describes flight-specific tasking from the time data is received on a flight until it enters the sector. *Sector Transit Tasks* outline the general handling of a flight through the sector, including the implementation of control decisions and transferring the flight to the next sector.

1.0 EN ROUTE SITUATION AWARENESS

Controllers form a mental picture of the traffic situation through knowledge of traffic status and dynamics, and awareness of environmental conditions. The formation of this mental picture is an internal cognitive task that controllers perform by receiving information from automation systems, airspace users, and other service providers. As a product of this ongoing situation monitoring, controllers make and prioritize control decisions within the context of the overall environmental and traffic situation.

1.1 MAINTAIN AWARENESS OF ENVIRONMENTAL CONDITIONS

ECON tasking is affected by airport/airspace configuration, wind and weather, and NAS infrastructure availability. Airport configuration is characterized by the runways in use. The airspace configuration consists of sectorization (i.e., sector combinations), dynamic sector boundary/shelf locations, and SUA status. Wind and weather largely determine the traffic complexity that will occur under given traffic loads. The status of NAS infrastructure components affects the set of traffic solutions that are available to the controller, both in terms of feasible aircraft trajectories (routings, etc.), and in terms of the information that automation can provide to the controller. These overall conditions provide the context within which controllers assess flight-specific information and make control decisions. Awareness of these conditions is maintained through the performance of the following tasks:

1.1.1 Maintain awareness of overall airspace conditions.

Task Objective — Determine general traffic-handling requirements, and provide feedback to supervisors and traffic managers for optimizing traffic- and workload-sharing.

Background (Sector) — The overall airspace environment is comprised of five elements, as follows:

- Primary airport configuration — Generally defined by the runways in use for arrivals and departures.
- Operational Plan — A descriptor of overall ECON and ADCON traffic flows, as generally defined by the primary airport configuration.
- Airspace configuration — The location of ADCON and ECON airspace boundaries and shelves. The airspace in both environments is configured in real time to support operational objectives arising from the airport configuration, and from internal traffic-handling requirements. The current configuration is depicted on sector map displays, which can be altered in real time to implement ad-hoc boundary reconfigurations. All alternative airspace configurations are available for map display.
- Sectorization — The combined/de-combined status of ECON and ADCON sectors.
- SUA status and near-term plans — Determines airspace availability. SUA status and schedules are distributed to sectors via the NAS-WIS. An SUA probe checks each flight across the length of its route. Near-term SUA conflict warnings are addressed to and handled by the sector. Long-range alerts are directed by the system to the supervisor, TM, and UOC.

Background *(Non-Sector) — Current status and long-range plans/schedules are automatically provided to the relevant Supervisor, TM, SOC, and UOC. TM and/or Supervisor also receive long-range SUA conflict warnings.*

Responsibility — **Sector Team:** Overall awareness and near-term SUA conflicts. **Supervisor and/or TM:** Sectorization, SUA schedule, airport/airspace reconfiguration, operational plan, and SUA avoidance initiatives.

Sector Information

- Automatically displayed: Current airspace configuration, SUA status, and near-term SUA conflict warnings.
- On-request: Current airport configuration, operational Plan, long-term schedules for airport configuration, airspace configuration, sectorization, and SUAs.

1.1.2 Assess current and predicted wind and weather.

Task Objective — Maintain awareness of airspace unavailability due to weather/turbulence, and determine the effect of winds on user-preferred routes, angles of climb/descent, groundspeeds, vectoring, and spacing.
Background (Sector) — Current information is distributed to all sectors, including wind, precipitation, visibility, and turbulence. Some of this information is transmitted in real time from aircraft.
Background (Non-Sector) — Extended weather reports and predictions are available to the supervisor, area coordinator, and TM. Weather information is also available on the flight deck via NAS-WIS/Datalink.
Responsibility — **Sector Team:** Assessment of operational impact. **Automation:** Distribution of information.
Sector Information On-request: Wind and weather reports.

1.1.3 Assimilate sector-relevant aeronautical information.

Task Objective — Maintain awareness of current NOTAMs, AIRMETs, etc., and assess their operational impact..
Background (Sector) — Existing information systems are interconnected in order for all real time aeronautical information to be disseminated via the NAS-WIS. Automation distributes information to users and service providers based on predefined defaults and appropriate security/access. Domestic and international information is standardized for content and format. The system analyzes data from all sources to determine the relevance to specific flights, routes, sectors, etc. Flight-specific applicability of an advisory is indicated on the flight objects of the appropriate aircraft.
Background (Non-Sector) — Aeronautical information is automatically distributed to the flight deck via NAS-WIS/Datalink.
Responsibility — **Automation:** Distribution of information to the sector and flight deck. **Sector Team:** Assessment of operational impact. **Pilot/UOC:** Flight deck receipt of appropriate information.
Sector Information — Automatically displayed: Advisory type, data content, applicable flights.

1.1.4 Assimilate sector-relevant NAS infrastructure information.

Task Objective — Maintain awareness of the status of sector-relevant NAS infrastructure components.
Background (Sector) — Infrastructure information is distributed via the NAS-WIS to describe the status of equipment such as landing aids, and capabilities such as conflict probe. Relevant off-nominal status is automatically displayed at the sector. Loss of infrastructure redundancy is also reported to the sector, even if no capabilities are currently affected. An event prompt for status changes arising from approved maintenance schedules is automatically displayed at a pre-determined time before the status change occurs. All information is conveyed to the controller in terms of the operational capabilities that will be affected.
Background (Non-Sector) —Maintenance schedules are coordinated among IM, TM, Supervisor, and users. Actual interruptions are reported to those entities, to the relevant sectors, and via NAS-WIS to users.
Responsibility — **Automation:** Distribution of information. **Sector Team:** Awareness of infrastructure effects on traffic operations. **IM/TM/Supervisor/Automation:** Infrastructure management.
Sector Information — Automatically displayed: Event prompt for planned status change, notification of unplanned off-nominal sector capability, estimated duration of off-nominal status.

1.2 MAINTAIN AWARENESS OF THE PENDING TRAFFIC SITUATION

Pending traffic is comprised of active flights not yet within or near the sector. Controllers maintain awareness of the pending situation through the use of flight-specific and non-flight-specific information. Flight-specific data is delivered to the sector well before each flight arrives at the sector. In the aggregate, this data describes the overall characteristics (i.e., route mixture, type mixture, general flows, etc.) of the approaching traffic. Non-flight-specific information is provided by TM DSSs that generate various types of traffic loading, scheduling, and delay information.

1.2.1 Monitor flight-specific information.

Task Objective — Determine overall characteristics (e.g., route mix, type mix, etc.) of impending traffic.
Background — Advance delivery of flight-specific data allows the controller to assess the general nature of pending traffic. Sector-defined information for each flight is available for display on a Flight Information Posting ((FIP), reference Task 1.3.1). FIPs for airborne flights are posted at a pre-determined time prior to sector-entry. Data for departures is available for posting at relevant ECON departure sectors immediately after a realistic departure time is known.[6] Only basic FIP information is required for this pending-traffic awareness task.

[6] Accurate departure-time predictions are provided well before the event at virtually all airports.

Responsibility — **Associate Tactical Controller, Area Coordinator:** Awareness of impending traffic characteristics and coordination requirements.

Sector Information

- Automatically displayed: Call sign, predicted departure time or sector-entry time.
- Automatically displayed or on-request: Basic flight information, such as route, type, and altitude.

1.2.2 Monitor non-flight-specific information.

Task Objective — Plan general traffic-handling requirements in accordance with predicted demand levels.

Background (Sector) — Controllers receive several types of non-flight-specific information that allows them to assess traffic in ECON airspace and at the airport. The system measures and predicts the traffic density at all sectors. Dynamic measurements and near-term predictions of each sector's traffic density are available *at that sector*. Other examples of non-flight-specific information that are available at the sector include timelines that provide schedule information, and load graphs that indicate traffic flow rates at selected fixes (e.g., meter fixes, departure fixes, etc.).

Background: (Non-Sector) — Densities at all sectors are available to TM, supervisor, and area coordinator.

Responsibility — **Sector Team:** Awareness of predicted demand levels, and the effects on traffic operations.

Sector Information — On-request: The sector's dynamic density prediction, traffic loading at relevant reference points, and schedule and delay information on relevant traffic flows.

1.3 MAINTAIN AWARENESS OF THE IMMEDIATE TRAFFIC SITUATION

The immediate traffic situation consists of flights currently within or near the sector. Awareness of the immediate situation is maintained by monitoring the sector's displays, receiving information from other service providers, and receiving information from the flight deck. The primary traffic information is provided via the situation display, and a tabular or graphic FIP that is available for each flight. All flight object data is available on these displays, including most inter-sector coordination and all datalink information. Some inter-sector coordination information, and most information from other service providers (i.e., TM, IM, etc.), is received via interphone. Information is received from the flight deck via datalink or radio. The following tasks describe the acquisition of information from these sources.

1.3.1 Monitor the sector's primary traffic information.

Task Objective — Visually detect in-sector conflicts, assure airspace integrity, determine flight task status, determine the timing of control actions, determine pilot-separation responsibilities, monitor aircraft conformance, receive silent coordination, determine the roles of surrounding sectors in the handling of each flight, receive DSS information, and activate NAS messages via system-generated input selection options.

Background — Current traffic is depicted on the situation display and on each flight's FIP. This information combines and expands upon the information traditionally provided by data blocks and flight progress strips, and integrates the data provided by various NAS components such as conflict probe, datalink, TM DSSs, etc.

- The situation display provides a real time, geographically-based depiction of the traffic situation through map data, targets, track position indicators, and flight object information output in association with the applicable track. An overall display and selectable insets provide general and expanded views of the traffic situation. Insets may also be used to describe conflicts detected by the system within and beyond the sector.
- FIPs present sector-defined flight object data, and system-generated input selection options. They may be displayed in any of several forms, as illustrated by the following examples:
  - FIPs can be output in tabular form in a dedicated window. This window can be divided into sub-windows, or 'bays.' FIPs are time-sequenced into the appropriate bays in the same manner as present day strips.
  - Upon controller request, a FIP can be output in association with the track on the situation display, to provide a 'fully expanded data block' capability.
  - FIP information may be output graphically, using either a geographical or time base. Geographically based FIP information may be output on the primary situation display or in a dedicated window. Time-based graphical information is output in a dedicated window.

Responsibility — **Sector Team.**

Sector Information — *(Note: Descriptions and operational applications of the following information types are provided under the relevant tasks throughout this task module.)*

- Situation display:
  - Automatically displayed: Airspace maps, track positions, flight status (IFR, non-flight-followed VFR, flight followed VFR), conflict warnings, task prompts, SUA event-prompts, and SUA status.

  - On-request: Terrain maps, track projections (vector lines, halos, route readouts, etc.) conflict & conflict resolution descriptions, and weather.
- Situation display and/or FIP:
  - Automatically displayed: Controller preplanning on received pointouts, response to pointouts from other sectors, handoff indicator, forced information forwarded from another sector.
  - Automatically displayed or on-request: Callsign, flight-specific input selection options, sector-entry times, current and assigned headings, altitudes, and speeds (IAS and Mach), current groundspeed, altitude profile data ('next requested altitude,' etc.), flight condition indicators (emergency, hijack, etc.), datalink message content, unacknowledged datalink clearance indicator, conflict warnings, full conflict and resolution information, TM DSS advisories (headings, altitudes and speeds), aircraft non-conformance indicators, pilot self-separation indicators, task prompts (handoff, communications transfer, unacknowledged datalink clearances, objectively time-constrained control actions, etc.), coordination information (sector in possession of the track, sector in communications with the flight, the level of control requested/received by one sector while the flight is in another sector's airspace, preplanned actions by the controlling sector, pointout responses by all sectors, the identities of all sectors observing the flight, etc.).

1.3.2 Receive internal and external interphone calls.

Task Objective — Receive information that is not feasibly communicated via sector displays.

Background — Interphone communications with other service providers are reduced by the information distributed via the situation display and FIP. However, a limited amount of inter-sector coordination continues to be performed verbally by interphone, and a significant amount of coordination with other service providers, such as traffic managers, is conducted verbally.

Responsibility — **Associate Tactical Controller and Area Coordinator.**

Sector Information — Verbal Information: Inter-sector coordination data, TM initiatives, supervisory initiatives.

1.3.3 Receive pilot-initiated datalink messages.

Task Objective — Receive requests, weather advisories, emergency advisories, and clearance acknowledgments.

Background (Sector) — Downlinked messages consist of user requests, advisories, and clearance acknowledgments. Arrival of a message is indicated at the sector by a visual and/or aural alert. Upon receipt of any message, a manual controller action results in a confirmation message being uplinked to the flight. Downlinked message content is output on the FIP. Emergency messages are discriminated for prioritization by the controller. Pilot requests for control actions are displayed as FIP input selection options. Unacknowledged datalink clearance status is indicated on the data block and/or FIP. Upon receipt of acknowledgment, the unacknowledged clearance indicator is automatically suppressed. If a clearance acknowledgment is not received after a pre-determined period of time, an 'unacknowledged clearance' task prompt is automatically displayed.

Background: (Non-Sector) — Some downlinked advisories, such as weather alerts and NOTAMs, are routed to and acknowledged by the NAS-WIS rather than the sector, and then distributed by the NAS-WIS per Task 1.1.3.

Responsibility — **Sector Team:** Awareness of datalink communications activity.

Sector Information — Automatically displayed: Alert of message arrival, message content, emergency discriminator, pilot-requested input selection option, suppression of unacknowledged clearance indicator upon receipt of acknowledgment, 'unacknowledged clearance' task prompt.

1.3.4 Receive pilot-initiated radio calls.

Task Objective — Maintain awareness of user requests, advisories, and emergency notifications, and ensure the flight's timely acknowledgment of clearances (whether issued via datalink or radio).

Background — Current radio communication methods are maintained.

Responsibility — **Tactical Controller:** Conduct all radio activity.

Sector Information — Verbal information: Flight ID, request, advisory, and emergency information, clearance acknowledgment

1.4 MAKE CONTROL DECISIONS & PLAN TASK PRIORITIES

As a product of situation monitoring, the controller makes control decisions — and prioritizes the resulting tasking — within the context of the overall traffic situation. A primary objective of this process is to determine a trajectory for each flight (i.e., speed, altitude, heading, etc.) that maintains safety, meets operational objectives, accommodates user preferences, and maximizes the use of self separation. The tasks required to meet these goals consist of 'procedural' tasks such as handoffs and communications transfers, and 'situational' tasks such as headings and interim altitudes to resolve conflicts. However, these classifications do not indicate a task's *criticality*. Instead, controller task priorities are largely a function of timing. For example, a procedural task such as a handoff can be as critical as an interim altitude to resolve a conflict, since a neglected handoff may *cause* a conflict.

To aid in identifying and prioritizing these actions, system-generated task prompts draw attention to uncompleted procedural tasks such as unacknowledged datalink clearances, unaccepted handoffs for flights nearing the sector boundary, etc. To direct attention to situational tasks, conflict detection aids identify conflicting flights and provide resolutions. The controller also performs trial planning to receive similar information for mentally generated or pilot-requested control action options. TM DSSs, such as arrival sequencing and spacing aids, provide situational control-action advisories that optimize traffic flows. Finally, these tools — in conjunction with enhanced information-sharing between the NAS, UOC, and flight deck — allow increased accommodation of user preferences and self separation. The following tasks describe the controller/automation interaction in the decision making process.

1.4.1 Assure air safety.

Task Objective — Make decisions that will avoid/resolve conflicts.

Background — The trajectory modeling that is used for automatic conflict detection and on-request trial planning is based on aircraft performance and weight, user operating characteristics, atmospheric conditions, applicable procedures, and user-preferences/pilot-intent. The resulting probes (either automatic or on-request) check for aircraft, SUA, terrain, and weather conflicts. These capabilities ease cognitive workload by augmenting the controller's mental trajectory analysis of specific flights and traffic pairs.

- User-specific models calculate aircraft performance as a function of the flight's current weight and prevailing atmospheric conditions. Current weight is acquired automatically via NAS-WIS/Datalink. Wind, temperature, and pressure aloft are acquired via NWS/NAS-WIS, including real time reports from aircraft. Procedural trajectory requirements (i.e., LOA-required altitude profiles, etc.) are sector-defined. User operating characteristics are determined through detailed analysis of historical flight object data. User preferences for all flights, and self-separation pilot-intent information, is input to the NAS automatically via NAS-WIS/Datalink.
- Since they involve trajectory modeling against large and stationary/slow-moving areas, SUA, terrain, and weather conflict probes are provided over a greater look-ahead time than is feasible for aircraft conflicts. Controllers are required to resolve SUA and terrain conflicts, and to use weather conflict information to assist the pilot in avoiding severe weather.
- Automatic conflict detection is provided at all sectors to warn of conflicting traffic and propose resolution options. The controller mentally analyzes the trajectories of the specified flights and selects the most advantageous option. This reduces cognitive workload by allowing the controller to perform less complex mental trajectory analysis of the rest of the traffic population that is considered problem-free by the system.
- On-request trial planning is provided at selected sectors to test mentally-generated or pilot-requested control actions for aircraft, SUA, terrain, and weather conflicts. Simple inputs and succinct system responses make trial planning feasible at a single-controller sector under high traffic volume and complexity. After executing a trial-planned action that is considered problem-free by the system, the controller is generally able to perform less complex mental trajectory analysis of the resulting traffic interactions.

Responsibility — **Automation:** Conflict detection & generation of resolution options. **Tactical Controller**: Near-term conflict resolution (e.g., aircraft, SUA, terrain, and weather). **Associate Tactical Controller:** Inter-sector coordination required to implement near-term conflict resolutions. **Area Coordinator and/or TM:** Long-range SUA, terrain, and weather conflict resolution.

Sector Information

- Automatically displayed: Near-term conflict warnings.
- On-request: Trial plan results, automatic and trial planned conflict description, conflict resolution options, input selection options for the selected resolution.

1.4.2 Meet procedural requirements.

Task Objective — Determine the tasks and timing required to implement procedurally required actions.

Background — Each flight's route, type, equipage, and destination define many procedurally-required tasks, based on LOAs and facility procedures. These actions include speed and altitude restrictions, handoffs, communications transfers, etc. Since high traffic volume and complexity in 2005 increases the difficulty of tracking the status of these tasks for each flight, the system provides prompts that draw attention to tasks that are both predictably required and objectively time-constrained. Examples of the available task prompts include such cases as:

- A flight that is not handed off is approaching a point from which boundary penetration cannot be avoided.

- A handed-off flight is approaching the boundary, and the communications transfer has not been completed.
- A datalink clearance has remained unacknowledged for a pre-determined period of time.
- A flight has reached a point at which a procedurally required control action must be implemented in order to meet applicable restrictions (i.e., a prompt for the top of an LOA-required descent).

Responsibility — **Tactical Controller.** Implementation of procedural clearances. **Associate Tactical Controller:** Implementation of procedurally required coordination.

Sector Information — Automatically displayed: Call sign, route/destination, type, equipage, and task prompts.

1.4.3 Conform to TM initiatives.

Task Objective — Determine the control actions and timing required to execute TM initiatives.

Background — TMs use arrival and departure demand projections to develop TM initiatives. Dynamic density predictions for all sectors are available at the TMU, including a monitor/alert function to indicate traffic overloading at specific sectors. Traffic loading at specified arrival and departure fixes are also provided by TM DSSs. Fast-time simulations are available to evaluate TM options. CDM between the TM and UOC facilitates development of user-preferred route structures, and allows a limited degree of user-preferred traffic sequencing. The initiatives developed with these tools and capabilities are generally communicated to controllers via TM DSS advisories.

- TM arrival flow initiatives are implemented in accordance with flight-specific control action advisories generated by TM sequencing and spacing aids. Arrival controllers utilize these speed, altitude and heading advisories to reduce workload and to optimize the arrival flow. Task prompts are available for all such advisories that are objectively time-constrained.
- TM departure flow initiatives are facilitated by accurate departure time estimates, and implemented through advisories generated by departure sequencing aids. This system-assisted departure staging optimizes the departure flow (including the integration of departures from satellite airports), and simplifies the coordination between the ECON and ADCON controllers.
- The system alerts TM to long-range SUA, terrain, and weather conflicts. Initiatives to resolve these conflicts are implemented by sectors that lie well upstream of the predicted event. Controllers are generally apprised of the required actions through silent coordination with TM. Task prompts are available for all such control actions that are objectively time-constrained.
- Sector overloads are detected by traffic load information produced by TM DSSs. This information consists primarily of dynamic densities, and traffic counts as a function of time (i.e., flow rates) at specified departure and arrival fixes. Overloads are prevented by de-combining sectors, altering sector boundaries, rerouting flights, or implementing ground delays. Traffic load information is provided to the area coordinator, TM and Supervisor, and the resulting plans are communicated to controllers either verbally or via sector displays for implementation.

Responsibility — **Tactical Controller:** TM initiative implementation. **TM:** TM initiative definition.

Sector Information

- Automatically displayed: TM DSS control-action advisories (heading, altitude, speed, etc.), and control action task prompts.
- On-request: The sector’s dynamic density prediction, traffic flow rates at relevant waypoints.

1.4.4 Accommodate Free Flight.

Task Objective — Make decisions that will either accommodate user-preferred trajectories, or minimize restrictions.

Background — The objective of Free Flight is to allow greater access to user-preferred trajectories, while imposing as few restrictions as possible. Fully unrestricted Free Flight allows users to depart on schedule, and then to operate on optimal altitude profiles and routes. However, departure times are affected by taxi-way and runway availability, and by the staging of multiple flights from multiple airports over the applicable departure waypoints. Optimal routes extend as close as feasible to the departure and arrival airports, while the routes themselves are generally defined by winds aloft. Optimal altitude profiles are characterized by uninterrupted climb to cruising altitude, an optimum top-of-descent, and uninterrupted descent to the runway.

- On-time departures are facilitated by surface management tools that improve the movement of flights from ramps to runways. These tools also manipulate actual departure times for optimum airborne traffic flow over the departure waypoints, with minimum overall departure delay. The system integrates arrival and departure activities at all airports within a terminal complex. Predicted departure times and flight-specific delay information are distributed to all relevant ECON departure sectors.
- Early entry of flights to their preferred routes is facilitated by improved staging over the departure waypoints. This extension of preferred routes closer in to the departure airport requires increased ECON airspace flexibility. However, since objectively-defined optimal routes between given geographic regions are used by all operators, the system’s reliable and accessible wind predictions tend to homogenize the Free Flight route mix.

Initial route requests are filed by the UOC, and appropriate route structuring is coordinated with national and facility traffic managers as required.

- Climbs to altitude are calculated based on aircraft performance, current weight, atmospheric conditions (wind, pressure, and temperature aloft), and user-supplied step-climb information. Using these variables, NAS calculates flight-specific climb profiles for use in conflict probing, and for determining dynamic boundary/shelf locations that minimize coordination for overall traffic flows. Under the current system, only the final requested altitude is available from flight plan data. In 2005, 'next requested altitude' data is distributed to the appropriate ECON sectors in a time-sequenced manner, and accommodated to the extent possible under prevailing environmental and traffic constraints.
- The latest possible egress from Free Flight routes is facilitated by improved arrival sequencing and spacing tools, thus extending preferred routes closer in to the destination airport. Speed control and vectoring for spacing are minimized prior to egress from the preferred route.
- Upon a flight's egress from Free Flight routings, the controllers' attempts to accommodate a continuous, optimal descent profile. The latest possible tops-of-descent are calculated by NAS based on aircraft performance and weight, optimum speed in descent, predicted length of route to the runway (based on traffic considerations), and winds aloft. These calculations are used for automatic conflict probes and (at sectors equipped with the capability) on-request trial planning. These tools increase the opportunities to eliminate speed and altitude restrictions on a per flight basis. At the appropriate time, the descent is automatically trial-planned and then distributed to the relevant sector as a conflict-free descent advisory. While uninterrupted descent remains the goal, interim descent altitudes based on the trial plan are distributed to the controller as required. Trial planning then continues automatically, providing the controller with 'next available altitude' data as the flight progresses. Descent profile data are also used to determine dynamic boundary locations that minimize coordination for overall traffic flows.

<u>Responsibility</u> — **Sector Team.**

<u>Sector Information</u> — Automatically displayed or on-request:

- Departures: Call sign, initial assigned altitude and crossing restrictions, initial requested altitude, initial assigned heading, departure waypoint, user-preferred route entry point.
- Arrivals: Call sign, destination, preferred-route egress point, top-of-descent point and/or time, TM DSS speed and heading advisories, initial trial planned descent altitude (either interim or final), subsequent interim/final descent altitudes (automatically provided as required).
- Overflights: Call sign, user-preferred route and altitude, trajectory revisions per automatic conflict detection.

1.4.5 Maximize the use of pilot self-separation.

<u>Task Objective</u> — Make decisions that will maximize the usage of self separation, in order to increase controller and airspace efficiency.

<u>Background</u> — CDTI extends the benefits of visual separation to all-weather ECON operations. This use of pilot-separation improves airspace efficiency by allowing more timely and precise aircraft maneuvering and speed control, and, when used, it eliminates repetitive controller tasks such as speed matching. CDTI-based self-separation is driven by aircraft equipage, and is implemented by as yet undefined procedures and separation minima. In general, that procedural environment will require the imposition of lateral and vertical deviation limits by the controller, airspace-sensitive conformance checking by the system, and pilot intent information from the flight deck. The use of self-separation requires the concurrence of both controller and pilot, but may be requested by either party. Pilots are cleared for self-separation between their flight and a single opposing flight identified by the controller. The following examples illustrate the types of situations in which self-separation might be used:

- Departures, arrivals, and overflights may perform stationkeeping within their respective traffic flows.
- Overflights and departures may overtake a leading flight (within their respective traffic flows) while maintaining vertical separation.
- Overflights and departures may maneuver laterally to overtake a leading flight (within their respective traffic flows) while maintaining or climbing through that flight's altitude.
- Overflights and departures may separate themselves from a flight in an interacting traffic flow.

<u>Responsibility</u> — Flight crew and controller responsibilities will be defined based on the procedural environment.

<u>Sector Information</u>

- Automatically displayed: Call sign, aircraft equipage, self-separation status, self separation deviation limits, event prompts for aircraft conformance and airspace violation.
- On-request: Collated list of call signs of associated self-separating flights.

1.4.6 Balance overall delay.

<u>Task Objective</u> — When making control decisions, consider the amount of delay each flight has already absorbed.

Background — The system provides 'cumulative delay' information that quantifies the total delay a flight absorbs from its ready-for-pushback time to its actual arrival time. TM DSSs use this information as one variable in the determination of traffic flow sequences. Cumulative delay data is also available for output on the FIP, which enables (but does not require) controllers to:

- Allocate discretionary tasktime to coordinate expedited trajectories for flights that have absorbed delay, rather than for flights that have not been delayed.
- Use cumulative delay as a 'tie-breaker' to determine traffic sequences.

Responsibility **— Sector Team.**

Sector Information — Automatically displayed or on-request: Cumulative delay.

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2.0 EN ROUTE SECTOR ENTRY

The tasks discussed above provide controllers with overall situation awareness, and allow the development of a prioritized task queue. The balance of this module assumes that the controller's task queue is implemented as flights are processed through the sector in two stages, i.e., sector entry and transit. The entry phase begins with receipt of a FIP, and ends when the flight enters the sector. During this time, controllers incorporate the data into their mental picture of the traffic situation, and manage the entry of the flight into the sector. As discussed below, the entry phase requires the controller to assess the impact of the approaching flight, respond to the handoff from an another sector, and establish communications with the flight.

2.1 ASSESS THE IMPACT OF THE APPROACHING FLIGHT

The following tasks describe the controllers' assimilation of information on the pending flight into their mental picture of the traffic situation. Each flight's FIP is posted at a pre-determined time prior to the flight's airspace entry, or when a realistic departure time is known. Upon delivery, the data is reviewed to determine the tasks the flight will generate. DSSs identify problems involving the flight, and allow them to be resolved through early coordination with the upstream controller.

2.1.1 Receive and review information on the approaching flight.

Task Objective — Assess the flight's newly-arrived data to determine general task requirements.

Background — Flight information is posted at a predetermined time prior to the arrival of the flight at the sector. To determine the tasks the flight will generate, controllers use basic flight object data that implicitly indicates such tasking as procedurally required descents for arrivals. In addition, system-generated cues explicitly indicate conflicts, and task requirements such as the need to issue preferential arrival routes, or execution of TM initiatives.

Responsibility — **Associate Tactical Controller, Area Coordinator:** Awareness of impending task requirements.

Sector Information

- Automatically displayed: Call sign, predicted sector-entry time, in-sector conflict warning.
- Automatically displayed or on-request: Aircraft type and equipage, present position, route and destination, current and assigned heading, altitude, and speed (IAS and Mach), DSS advisories, flight condition indicator (emergency, hijack, communications failure, etc.), conflict and resolution data, pilot self-separation indicator, self-separation deviation limits, self-separation pilot-intent, coordination information (sector possessing the track, communicating sector, level of control requested/received, preplanned actions by the controlling sector, identities of sectors observing the flight, etc.).

2.1.2 Perform inter-sector coordination either to resolve conflicts or to expedite traffic.

Task Objective — Facilitate traffic safety and efficiency through improved coordination prior to sector entry.

Background — Silent coordination may be used to 1) resolve conflicts well before the flight enters the sector, and 2) to arrange the implementation of expedited trajectories by an upstream sector.

- Conflict Resolution. The system reports conflicts and resolution options to the sector in which the conflicts will occur. If action prior to airspace entry is desirable, coordination is initiated to have that action implemented by the upstream sector. To execute this coordination silently, the initiating controller forces the output of the appropriate control instruction on the upstream controller's display to indicate the conditions the flight must meet prior to sector-entry.
- Expedited Trajectory. The controller may silently coordinate with an upstream sector to deliver an expedited routing or a more desirable altitude profile to a flight. To do so, the controller may either 1) force the output of the appropriate control instruction on the upstream controller's display to indicate the conditions the flight must meet prior to sector-entry, or 2) using the preplanning function, force the appropriate preplanned control instruction on the upstream sector displays in the form of a request which the upstream controller may either accept or reject.

Responsibility — **Associate Tactical Controller:** Near-term coordination. **Area Coordinator:** Long-range coordination.

Sector Information

- Automatically displayed: Call sign, conflict warning, control instruction issued to upstream sector.
- On-request: Conflict description, resolution options.

2.2 RECEIVE THE APPROACHING FLIGHT

ECON sectors receive handoffs on flights from other sectors (ECON or ADCON), and they locate and initiate ATC services on pop-ups. The current tasking to radar identify pop-ups is eliminated by improved surveillance equipment and processing in 2005. Communications with flights received from another sector are generally established after handoff, and prior to sector entry. Communications with datalink-equipped flights are transferred to the receiving sector as a result of a computer input by the transferring controller.

2.2.1 Initiate ATC services for pop-ups.

Task Objective — Locate a pop-up, and respond to the flight's requests/requirements.

Background — Advanced aircraft surveillance equipment and NAS processes utilize permanent, discrete signaling by individual aircraft. This allows each appropriately equipped aircraft in covered airspace to be automatically identified and continuously tracked by the system. As a result, current controller tasking involved in radar-identifying pop-ups is fully automated. At the first sector to work the flight, the controller locates the flight via surveillance data and initiates services, as follows.

- Situation data on non-flight-followed VFR flights is available per controller-selectable altitude filters. Associated with the target are 1) a limited data block that includes a flight status indicator and altitude readout, and 2) a sector-defined full data block and FIP which may be displayed on request.
- Full data blocks and FIPs on non-flight-followed VFR flights that wish to receive ATC services are automatically displayed based on the pilot-selected setting of the airborne equipment. (Prior to the pilot's selection of this setting, the flight is available for display as a target and limited data block, as discussed above.) These flights may either request VFR flight following or an IFR flight plan. In either case, a flight profile (if one is filed) is associated with the track.

Responsibility — **Automation:** Surveillance identification and altitude verification. **Tactical Controller:** Awareness of the flight's location and initiation of ATC services.

Sector Information

- Non-flight-followed VFR flights:
  - Automatically displayed, per altitude filters: Target, VFR indicator, and current altitude.
  - On-request: Full data block, track projections (vector line, halo, route readout, etc.), and FIP.
- Flight-followed VFR flights:
  - Automatically displayed: Target, full data block, and FIP.
  - On-request: Track projections

2.2.2 Receive a flight from another sector.

(a) Observe handoff notification.

Task Objective — Visually assess the immediate impact of the flight's entry into the sector.

Background — NAS determines which sectors will receive a handoff on the flight, and which sectors will receive a pointout. Handoffs are generally system-initiated at a pre-established time or distance from the sector boundary. Prior to handoff initiation, the flight can be observed via limited data block. Upon handoff initiation, a full data block is displayed and an expanded FIP is output per sector-defined requirements.

Responsibility — **Tactical Controller or Associate Tactical Controller**.[7]

Sector Information

- Automatically displayed: Target, full data block, handoff indication, and FIP.
- On-request: Track projections.

(b) Plan for timely handoff acceptance or alternative action.

Task Objective — Maintain airspace integrity with minimal coordination.

Background — As the flight approaches the protected airspace of the receiving sector in handoff status, trajectory modeling determines the point at which airspace penetration is unavoidable. An indicator is provided at the initiating and receiving sectors that prompts the controllers to take the appropriate action when a flight approaches this point without the handoff being completed.

Responsibility — **Tactical Controller or Associate Tactical Controller.**

Sector Information — Automatically displayed: 'Uncompleted-handoff' task prompt.

[7] The responsibilities of the two controllers for handoff assessment and acceptance varies at different facilities.

(c) Request control, if required, and accept or reject the handoff.

Task Objectives — 1) Gain the authority to implement control actions prior to the flight's entry into the sector, if required. 2) Indicate approval/disapproval for the flight's entry into the sector.

Background

- Handoff Acceptance: Situations often require the receiving sector to control a flight in the transferring sector. An automated method to negotiate control during the handoff transaction is provided, as follows.
  - The transferring sector may preemptively release various levels of control (i.e., complete control, control for turns, etc.) as part of a manually initiated handoff.
  - The receiving sector may request various levels of control as part of the handoff acceptance.
  - A request by the receiving sector, or a preemptive release by the transferring sector, can either be accepted or counter-offered by the other sector as part of the continuing handoff transaction. At any point in this dialogue, an acceptance input by the responding sector completes the handoff.
  - Handoff status and the level of control released to the receiving sector are output on the displays of all sectors involved in the handling of the flight.
- Handoff Rejection. The receiving sector may reject the handoff if agreement is not reached in the control negotiation discussed above, or for unrelated reasons. In either case, a handoff rejection suppresses the flight's data at the receiving sector, and sends a notification of handoff rejection to the transferring sector.

Responsibility — **Tactical Controller or Associate Tactical Controller.**

Sector Information — Automatically displayed: Indication of handoff status, level of control preemptively released by the transferring sector, level of control requested by receiving sector, indication of handoff acceptance and level of control ultimately released, notification to the transferring sector of handoff rejection.

(d) Enable Automatic Handoff Acceptance *(Controller-Selectable Capability)*.

Task Objective — Maintain awareness of arriving traffic.

Background — Controllers can enable a function which automatically accepts handoffs on flights that are projected to be conflict-free across the sector. This function can be enabled/disabled at will. If this function is disabled, handoffs are processed according to tasks (a) through (c) above. When enabled, the function accepts the handoff for each conflict-free flight at its penetration avoidance point. Handoffs on flights for which a conflict is predicted must be accepted manually. The data objects for flights with a projected in-sector conflict are emphasized to indicate the need for manual handoff acceptance. Prior to automatic handoff acceptance, the receiving controller can manually intervene, on a per flight basis, to reject the handoff or to initiate a request for control.

Responsibility — **Sector Team:** Accountability for automatically accepted handoffs.

Sector Information — Automatically displayed: Auto-Accept "Enabled" status, target, data block, notification of requirement for manual acceptance.

(e) Receive initial datalink contact.

Task Objectives — Verify datalink messaging authority (connectivity) with the flight, and verify the flight is tuned to the voice frequency.

Background — The transferring controller enters a NAS/datalink message which 1) instructs the flight to change voice-frequencies and 2) transfers datalink authority to the receiving sector. The uplinked message either directs the flight to contact or monitor the receiving sector, and specifies the new voice frequency. Upon receiving the message, the flight crew resets their radio and makes the initial call if so directed. The flight's frequency selection is automatically downlinked to the NAS. If the flight resets to an incorrect frequency, the datalink instruction is automatically sent again. When the flight's setting is correct, the sector corresponding to that setting is identified as the communicating sector. The identity of the sector in contact with the flight is distributed to all sectors.

Responsibility — **Sector Team:** Maintain awareness of all datalink activity.

Information — Automatically displayed: Communicating sector ID, radio 'monitor' status (receiving sector only).

(f) Receive initial call from a datalink-equipped flight.

Task Objectives — Verify the flight is on frequency.

Background — Those flights which are directed to contact the receiving sector will report on frequency, and receive verbal acknowledgment from the controller. Current and assigned altitudes are not reported by the flight.

Responsibility — **Tactical Controller:** Conduct all radio activity

Sector Information — Verbal information: Call sign, and 'on-frequency' report.

Note: The procedure for initial radio calls by non-datalink-equipped flights is generally unchanged from current practices, except that the receiving controller enters a NAS message to indicate the flight is on frequency. After *the communications transfer is completed for any flight, the receiving sector assures separation from traffic in the transferring sector by exercising only the level of control granted by that sector while the flight is in that airspace.*

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3.0 EN ROUTE SECTOR TRANSIT

The transit phase of a flight begins when the sector is communicating with the flight and has authority to control it. This phase ends when the flight exits the sector's airspace. During the intervening period, the controller performs the tasks required to implement control decisions, transfer control of the flight to the downstream sector, transfer communications, and monitor the flight until it is beyond the boundary and clear of the sector's other traffic.

3.1 IMPLEMENT CONTROL DECISIONS

As discussed earlier, controllers make flight-specific decisions within the context of the overall traffic situation. The objectives of these decisions are to detect and resolve conflicts, accomplish procedural requirements, execute TM initiatives, and accommodate user-preferences and self separation. The flight-specific tasks generated by these decisions primarily involve inter-sector coordination, and the issuance of clearances and advisories.

3.1.1 Perform inter-sector coordination.

Task Objective — Receive/forward control information and pilot requests, coordinate to gain approval for a flight's current trajectory, and coordinate to gain approval for changing a flight's trajectory.

Background — Most coordination is performed silently, and the results are available for display at all sectors involved in handling the flight. Silent coordination can be executed by any member of the sector team. Verbal coordination (generally performed by the Associate Tactical Controller or Area Coordinator) is only used to forward atypical information or in instances when silent coordination is not practical.

- Pilot requests and basic control information are forwarded via data blocks and FIPs. To ensure that the formats and filters in use at the receiving sector do not suppress information a controller wishes to forward, specific control information can be forced on the receiving sector's displays.
- Under the current system, controllers manually initiate pointouts to gain approval for a flight to enter the affected sector along its current trajectory, or to coordinate a change in the flight's trajectory that will affect the other sector. In 2005, pointouts are conducted as follows:
  - Pointouts to gain approval for the flight's current trajectory are automatically initiated.
  - If a trajectory change does not require pre-approval, the controller enters the revised trajectory, and the system automatically initiates any required pointouts.
  - Pointouts to coordinate a change in a flight's trajectory continue to be manually initiated. The controller first utilizes the preplanning capability to display the desired control actions on the flight's data block and FIP, and then initiates the pointout.
  - Automatic and manually initiated pointouts force the flight's data block and FIP on the displays of the appropriate sector(s). The forced information includes the preplanned actions of the initiating controller.
  - The receiving controller utilizes the pointout response capability to approve or disapprove the pointout. This capability allows conditional approval for airspace entry (i.e., at or above a specified altitude, east of a specified fix, etc.). It also provides an 'Accept Handoff' option to indicate that airspace entry is approved, and that the receiving sector will work the flight. The 'Accept Handoff' option provides the capability for control negotiations as discussed earlier.
- Coordination on a flight that is not within the affected sector's geographical area of interest is performed using a manually initiated FIP pointout in which only the information posting of the flight is forced on the display of the receiving sector. The coordination process is the same as the full pointout, including the preplanning function and all of the response capabilities except for the 'Accept Handoff' option.
- Other forms of inter-sector coordination discussed earlier are:
  - Conflict resolutions prior to airspace entry (reference Task 2.1.2).
  - Control negotiations conducted on handoff (reference Task 2.2.2c).

Responsibility — **Sector Team:** Near-term silent coordination. **Associate Tactical Controller:** Near-term verbal coordination. **Area Coordinator:** Long-range coordination.

Sector Information — Automatically displayed: Forced control information & pilot requests, pointed out datablocks and FIPs (including preplanned actions by the initiating controller), pointout response (approved, approval conditions, disapproved, 'Accept Handoff').

3.1.2 Issue clearances.

Task Objective — Manipulate flight trajectories (heading/route, altitude, speed, etc.).

Background — Most clearances are intended to implement changes in the flight's trajectory. Upon acknowledgment by the flight, each clearance becomes the flight's current trajectory information that is automatically distributed to all sectors observing the flight. Both radio and datalink are used with equal utility to issue clearances.[8] Tactical Controllers issue clearances via radio or datalink, and direct the datalink issuance of clearances by the other members of the sector team. Together, the sector's radio and datalink messaging allows an increase in the number of clearances that can be implemented per unit time.

- All trajectory information is entered into the NAS using the applicable computer message.
- For clearances issued via datalink, the input of the NAS message triggers the automatic composition of the appropriate datalink message, based on the flight ID, message type, and input value of the NAS message. The composed datalink message is displayed to the controller for review, edited if necessary, and then transmitted. Upon transmission, the new control information is indicated on the flight's data objects as an unacknowledged datalink clearance. While awaiting acknowledgment of the clearance, controllers are free to perform other tasks. When acknowledgment is received, the information is displayed as the current trajectory information for the flight, and the clearance task cycle is complete. If no acknowledgment is received after a pre-determined time, an 'unacknowledged clearance' task prompt is presented to the controller, who then takes the appropriate action to assure aircraft compliance.
- For clearances issued via radio, the controller enters the NAS message during clearance issuance and readback. Entry of the NAS message immediately updates the current trajectory information on the flight.

Responsibility — **Tactical Controller:** All radio clearances. **Sector Team:** Datalink clearances, as directed by the Tactical Controller.

Sector Information

- Input information: Datalink activation, flight ID, NAS message type, input data value(s), datalink message editing, datalink 'transmit' action.
- Automatically displayed information: Current trajectory information, composed datalink message (for review and editing), cleared but unacknowledged trajectory information with 'unacknowledged clearance' indicator, 'unacknowledged clearance' task prompt.

3.1.3 Provide IFR and VFR advisories and on-request information updates.

Task Objective — Provide information that promotes air safety and/or user planning (i.e., traffic advisories, PIREPs, NOTAMs, NAS infrastructure outage reports, etc.).

Background — Traffic, weather, SUA, terrain, and infrastructure advisories are provided to all IFR flights. In addition, these advisories are provided to VFR flights on an as-able basis, at the discretion of the controller.

- Under the current system, traffic advisories are verbiage-intensive, and the same advisory is often quoted numerous times to a flight until the traffic is sighted. In the transitional environment of 2005, the traffic's equipage mixture necessitates a variety of techniques for issuing traffic advisories.
  - No advisory is required for a CDTI-equipped flight if the opposing traffic is equipped for CDTI detection and full-data CDTI display.
  - A single advisory is required for a CDTI-equipped flight if the opposing traffic is equipped for limited-data CDTI display. These advisories are manually issued via datalink, using system-assisted message composition.
  - Traditional advisories are required for non-datalink or non-CDTI-equipped flights.
- Flights with access to NAS-WIS/Datalink automatically receive information such as altimeter settings, ATIS, PIREPs, NOTAMs, AIRMETs, SIGMETs, NAS infrastructure outage reports, etc.
- The system automatically provides a terrain alert according to either the assigned or reported altitude of the flight. All alerts are output at the sector in the form of an event prompt. Non-datalink-equipped flights receive the alert from the controller via radio. Datalink-equipped flights receive the alert automatically.
- Weather, SUA, and infrastructure information updates are provided upon request. If time does not permit the controller to fulfill a request, the flight may be cleared to contact the Flight Advisory Services in-flight advisor for the information update (reference Section C, Part 2).

Responsibility — **Tactical Controller:** All radio advisories. **Sector Team:** Datalink advisories, as directed by the Tactical Controller. **Automation (NAS-WIS/Datalink):** Altimeter settings, PIREPs, NOTAMs, AIRMETs, etc.

Sector Information — Automatically displayed or-request: Call sign, applicable traffic, altimeter settings, PIREPs, NOTAMs, AIRMETs, SIGMETs, SUA status, weather, NAS infrastructure status and schedule.

[8] The tactical usage of datalink as required by this task assumes an very rapid uplink/downlink capability.

3.2 TRANSFER THE FLIGHT TO THE NEXT SECTOR

3.2.1 Ensure timely handoff initiation.

Task Objective — Maintain airspace integrity by ensuring that handoff notification is made to the downstream sector well before the flight crosses the boundary.
Background — The timing parameter for handoff initiation provides the receiving controller with sufficient time to analyze the traffic situation, conduct appropriate planning, and perform any necessary coordination. The transferring sector is responsible for initiating the handoff, or for ensuring that automatic initiation occurs.
Responsibility — **Sector Team.**
Information — Automatically displayed information: Map data, track position, handoff notification.

3.2.2 Release control to downstream sector if requested.

Control negotiations on handoff are discussed in Task 2.2.2c.

3.2.3 Ensure timely handoff acceptance or rejection.

Task Objective — Ensure the flight is approved to enter the next sector, or take appropriate alternative action.
Background — The system provides an ‘uncompleted handoff’ task prompt to indicate that a flight in handoff status is approaching its penetration avoidance point. If the handoff or other coordination is not completed at that point, the transferring sector must retract the handoff and divert the flight away from the boundary.
Responsibility — **Sector Team.**
Information — Automatically displayed information: Handoff acceptance indicator, handoff rejection indicator, ‘uncompleted handoff’ task prompt at both sectors.

3.2.4 Issue communications change to a datalink-equipped flight.

Communications are transferred when the traffic situation requires no further information exchange with the flight. The transfer process is discussed in Task 2.2.2e.

3.2.5 Suppress the flight’s FIP and indicate non-communicating status on the situation display.

Task Objective — 1) Minimize screen clutter by suppressing the flight’s FIP. 2) Indicate on the situation display that problem resolutions requiring communications with the flight are no longer feasible.
Background — Upon the transfer of communications, the FIP is automatically suppressed. The data block remains displayed until after the flight exits the airspace. The identity of the communicating sector is shown in the data block. Other indicators of non-communicating status are also available, such as a dimmed data block.
Responsibility — **Automation.**
Information — Non-communicating status

3.2.6 Suppress the flight’s data block.

Task Objective — Minimize screen clutter by suppressing the data block when the flight can no longer affect other traffic in the sector, regardless of any aircraft non-conformance.
Background — Sectors can be defined in automation either to suppress data blocks automatically at a predetermined distance outside the sector’s airspace, or for manual suppression by the controller when the flight is outside of the sector’s airspace and clear of all other sector traffic.
Responsibility — **Tactical Controller or automation.**
Information — Map data, track data, distance from the boundary.

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PART 2 — ARRIVAL/DEPARTURE CONTROL (ADCON) TASK MODULE

This Part describes Arrival/Departure Control (ADCON) tasking in 2005. Sectors dedicated to ADCON tasks are operated by one or two Tactical Controllers. The second controller may operate at the sector or from a non-co-located position, and may assist in the operation of more than one sector. This module presents a representative set of tasks as they are performed under the level of automation envisioned for 2005, as follows: *Overall Situation Awareness Tasks* describe the tasks required to remain aware of environmental and traffic conditions, and to make and prioritize decisions. *Sector Entry Tasks* describes flight-specific tasking from the time data is received on a flight until it enters the sector. *Sector Transit Tasks* outline the handling of a flight through the sector, including the execution of control decisions and transferring the flight to the next sector or tower.

1.0 ADCON SITUATION AWARENESS

Controllers form a mental picture of the traffic situation through knowledge of traffic status and dynamics, and awareness of environmental conditions. The formation of this mental picture is an internal cognitive task that controllers perform by receiving information from automation systems, airspace users, and other service providers. As a product of this ongoing situation monitoring, controllers make and prioritize control decisions within the context of the overall environmental and traffic situation.

1.1 MAINTAIN AWARENESS OF ENVIRONMENTAL CONDITIONS

ADCON tasking is affected by airport/airspace configuration, operational strategy, wind and weather, and NAS infrastructure availability. Airport configuration is characterized by the runways in use. The operational strategy describes the runway utilization scheme. The airspace configuration consists of sectorization (i.e., sector combinations), dynamic sector boundary/shelf locations, and SUA status. Wind and weather largely determine the traffic complexity that will occur under given traffic loads and airport/airspace configurations. The status of NAS infrastructure components affects the set of traffic solutions that are available to the controller, both in terms of feasible aircraft trajectories (routings, etc.), and in terms of the information that automation can provide to the controller. These overall conditions provide the context within which controllers assess flight-specific information and make control decisions. Awareness of these conditions is maintained through the performance of the following tasks:

1.1.1 Maintain awareness of overall airport and airspace conditions.

Task Objective — Determine general traffic-handling requirements, and provide feedback to supervisors and traffic managers for optimizing traffic- and workload-sharing.

Background (Sector) — The overall airport and airspace environment is comprised of seven elements, as follows:

- Airport configuration — Generally defined by the runways in use for arrivals and departures.
- Airport conditions — Surface conditions that affect airborne traffic flows, such as runway conditions, taxi way conditions and availability, etc.
- Operational strategy— The runway utilization scheme for approach and departure staging (simultaneous or parallel approaches, departure banks, etc.).
- Operational Plan — A descriptor of overall ECON and ADCON traffic flows, as generally defined by the primary airport configuration.
- Airspace configuration — The location of ADCON and ECON airspace boundaries and shelves. The airspace in both environments is configured in real time to support operational objectives arising from the airport configuration, and from internal traffic-handling requirements. The current configuration is depicted on sector map displays, which can be altered in real time to implement ad-hoc boundary reconfigurations. All alternative airspace configurations are available for map display.
- Sectorization — The combined/de-combined status of ECON and ADCON sectors.
- SUA status and near-term plans — Determines airspace availability. SUA status and schedules are distributed to sectors via the NAS-WIS. An SUA probe checks each flight across the length of its route. Near-term SUA conflict warnings are addressed to and handled by the sector. Long-range alerts are directed by the system to the supervisor, TM, and UOC.

Background *(Non-Sector) — Current status and long-range plans/schedules are automatically provided to the relevant Supervisor, TM, SOC, and UOC. TM and/or Supervisor also receive long-range SUA conflict warnings.*

Responsibility — **Tactical Controller(s):** Overall awareness and near-term SUA conflicts. **Supervisor/TM:** Sectorization, SUA schedule, airport/airspace reconfiguration, operational strategy and Plan, and SUA initiatives.

Sector Information

- Automatically displayed: Current airspace configuration, SUA status, and near-term SUA conflict warnings.
- On-request: Current airport configuration, operational strategies, operational Plan, airport capacity constraints (runway/taxi-way conditions, etc.), airport capacity metrics (AAR, etc.), and long-term schedules for airport configuration, airspace configuration, sectorization, and SUAs.

1.1.2 Assess current and predicted wind and weather.

Task Objective — Maintain awareness of airspace availability due to weather/turbulence, and determine the effect of winds on arrivals and departures (e.g., angles of climb/descent, groundspeeds, vectoring, and spacing).
Background (Sector) — Current information is distributed to all sectors, including wind, precipitation, visibility, and turbulence. Some of this information is transmitted in real time from aircraft.
Background (Non-Sector) — Extended weather reports and predictions are available to the supervisor and TM. Weather information is also available on the flight deck via NAS-WIS/Datalink.
Responsibility — **Tactical Controller(s):** Assessment of operational impact. **Automation:** Data distribution.
Sector Information On-request: Wind and weather reports.

1.1.3 Assimilate sector-relevant aeronautical information.

Task Objective — Maintain awareness of current NOTAMs, AIRMETs, etc., and assess their operational impact.
Background (Sector) — Existing information systems are interconnected in order for all real time aeronautical information to be disseminated via the NAS-WIS. Automation distributes information to users and service providers based on predefined defaults and appropriate security/access. Domestic and international information is standardized for content and format. The system analyzes data from all sources to determine the relevance to specific flights, routes, sectors, etc. Flight-specific applicability of an advisory is indicated on the flight objects of the appropriate aircraft.
Background (Non-Sector) — Aeronautical information is automatically distributed to the flight deck via NAS-WIS/Datalink.
Responsibility — **Automation:** Distribution of information to the sector and flight deck. **Tactical Controller(s):** Assessment of operational impact. **Pilot/UOC:** Flight deck receipt of appropriate information.
Sector Information — Automatically displayed: Advisory type, data content, applicable flights.

1.1.4 Assimilate sector-relevant NAS infrastructure information.

Task Objective — Maintain awareness of the status of sector-relevant NAS infrastructure components.
Background (Sector) — Infrastructure information is distributed via the NAS-WIS to describe the status of equipment such as landing aids, and capabilities such as conflict probe. Relevant off-nominal status is automatically displayed at the sector. Loss of infrastructure redundancy is also reported to the sector, even if no capabilities are currently affected. An event prompt for status changes arising from approved maintenance schedules is automatically displayed at a pre-determined time before the status change occurs. All information is conveyed to the controller in terms of the operational capabilities that will be affected.
Background (Non-Sector) —Maintenance schedules are coordinated among IM, TM, Supervisor, and users. Actual interruptions are reported to those entities, to the relevant sectors, and via NAS-WIS to users.
Responsibility — **Automation:** Distribution of information. **Tactical Controller(s):** Awareness of infrastructure effects on traffic operations. **IM/TM/Supervisor/Automation:** Infrastructure management.
Sector Information — Automatically displayed: Event prompt for planned status change, notification of unplanned off-nominal sector capability, estimated duration of off-nominal status.

1.2 MAINTAIN AWARENESS OF THE PENDING TRAFFIC SITUATION

The pending traffic situation is comprised of airborne flights not yet within or near the sector, and non-imminent departures for which the system has predicted realistic departure times. Controllers maintain awareness of the pending situation through the use of flight-specific and non-flight-specific information. Flight-specific data is delivered to the sector well before each flight arrives at the sector or departs from the airport. In the aggregate, this data describes the overall characteristics (i.e., route mixture, type mixture, general flows, etc.) of the approaching traffic. Non-flight-specific information is provided by TM DSSs that generate various types of traffic loading, scheduling, and delay information.

1.2.1 Monitor flight-specific information.

Task Objective — Determine overall characteristics (e.g., route mix, type mix, etc.) of impending traffic.

Background — Advance delivery of flight-specific data allows the controller to assess the general nature of pending traffic. Sector-defined information for each flight is available for display on a Flight Information Posting ((FIP), reference Task 1.3.1). FIPs for airborne flights are posted at a pre-determined time prior to sector-entry. Data for departures is posted immediately after a realistic departure time is known.[9] While the FIP is capable of providing extensive information, only basic flight information is required for this pending-traffic awareness task.

Responsibility —**Tactical Controller(s):** Awareness of impending traffic characteristics and coordination requirements.

Sector Information

- Automatically displayed: Call sign, predicted departure time or sector-entry time.
- Automatically displayed or on-request: Basic flight information, such as route, type, and altitude.

1.2.2 Monitor non-flight-specific information.

Task Objective — Plan general traffic-handling requirements in accordance with predicted demand levels.

Background — Controllers receive several types of non-flight-specific information that allows them to assess traffic in ECON and ADCON airspace, and on the airport. This information is used to determine arrival and departure traffic loading for selected reference points (e.g., meter fixes, departure fixes, etc.). Examples of this type of data include timelines that provide schedule information, and load graphs that indicate traffic flow rates at selected fixes.

Responsibility — **Tactical Controller(s):** Awareness of predicted demand levels, and the effects on traffic operations.

Sector Information — On-request: Traffic loading at relevant reference points, and schedule and delay information on relevant traffic flows.

1.3 MAINTAIN AWARENESS OF THE IMMEDIATE TRAFFIC SITUATION

The immediate traffic situation consists of imminent departures, and airborne flights currently within or near the sector. Awareness of the immediate situation is maintained by monitoring the sector's displays, by receiving information from other service providers, and by receiving information from the flight deck. The sector's primary traffic information is provided via the situation display, and a tabular or graphic FIP that is available for each flight. All flight object data is available on these displays, including most inter-sector coordination and datalink information. Some inter-sector coordination information, and most information from other service providers (i.e., TM, IM, Supervisor, etc.), is received via interphone. Information is received from the flight deck via datalink or radio. The following tasks describe the acquisition of information from these sources.

1.3.1 Monitor the sector's primary traffic information.

Task Objective — Visually detect in-sector conflicts, assure airspace integrity, determine flight task status, determine the timing of control actions, determine pilot-separation responsibilities, monitor aircraft conformance, receive silent coordination, determine the roles of surrounding sectors in the handling of each flight, receive DSS information, and activate NAS messages via system-generated input selection options.

Background — Current traffic is depicted on the situation display and on each flight's FIP. This information combines and expands upon the information traditionally provided by data blocks and flight progress strips, and integrates the data provided by various NAS components such as conflict probe, datalink, TM DSSs, etc.

- The situation display provides a real time, geographically-based depiction of the traffic situation through the use of map data, targets, track position indicators, and flight object information that is output in association with the applicable track. An overall display and selectable inset windows provide general and expanded views of the traffic situation. Inset windows may also be used to describe conflicts detected by the system within and beyond the sector.
- FIPs present sector-defined flight object data, and system-generated input selection options. They may be displayed in any of several forms, as illustrated by the following examples:
  - FIPs can be output in tabular form in a dedicated window. This window can be divided into sub-windows, or 'bays.' FIPs are time-sequenced into the appropriate bays in the same manner as present day strips.

[9] Accurate departure-time predictions are provided well before the event at virtually all airports.

  - Upon controller request, a FIP can be output in association with the track on the situation display, to provide a 'fully expanded data block' capability.
  - FIP information may be output graphically, using either a geographical or time base. Geographically based FIP information may be output on the primary situation display or in a dedicated window. Time-based graphical information is output in a dedicated window.

Responsibility — **Tactical Controller(s).**

Sector Information — *(Applications of the following information are discussed throughout this task model.)*

- Situation display:
  - Automatically displayed: Airspace maps, track positions, flight status (IFR, non-flight-followed VFR, flight followed VFR), conflict warnings, task prompts, SUA event-prompts, and SUA status.
  - On-request: Terrain maps, track projections (vector lines, halos, route readouts, etc.) conflict & conflict resolution descriptions, and weather.
- Situation display and/or FIP:
  - Automatically displayed: Controller preplanning on received pointouts, response to pointouts from other sectors, handoff indicator, forced information forwarded from another sector.
  - Automatically displayed or on-request: Callsign, flight-specific input selection options, departure or sector-entry times, current and assigned headings, altitudes, and speeds (IAS and Mack), groundspeed, altitude profile data ('initial requested altitude,' etc.), flight condition indicators (emergency, hijack, communications failure, etc.), datalink message content, unacknowledged datalink clearance indicator, conflict warnings, full conflict and resolution information, TM DSS advisories (headings, altitudes and speeds), aircraft non-conformance indicators, pilot self-separation indicators, task prompts (handoff, communications transfer, unacknowledged datalink clearances, objectively time-constrained control actions, etc.), coordination information (sector in possession of the track, sector in communications with the flight, the level of control requested/received by one sector while the flight is in another sector's airspace, preplanned actions by the controlling sector, pointout responses by all sectors, the identities of all sectors observing the flight, etc.).

1.3.2 Receive internal and external interphone calls.

Task Objective — Receive information that is not feasibly communicated silently via sector displays.

Background — Interphone communications with other service providers are reduced by the information distributed via the situation display and FIP. However, a limited amount of inter-sector coordination continues to be performed verbally by interphone, and a significant amount of coordination with other service providers, such as traffic managers, is conducted verbally.

Responsibility — **Tactical Controller(s).**

Sector Information — Verbal Information: Inter-sector coordination data, TM initiatives, supervisory initiatives.

1.3.3 Receive pilot-initiated datalink messages.

Task Objective — Receive requests, weather advisories, emergency advisories, and clearance acknowledgments.

Background (Sector) — Downlinked messages consist of user requests, advisories, and clearance acknowledgments. Arrival of a message is indicated at the sector by a visual and/or aural alert. Upon receipt of any message, a manual controller action results in a confirmation message being uplinked to the flight. Downlinked message content is output on the FIP. Emergency messages are discriminated for prioritization by the controller. Pilot requests for control actions are displayed as FIP input selection options. Unacknowledged datalink clearance status is indicated on the data block and/or FIP. Upon receipt of acknowledgment, the unacknowledged clearance indicator is automatically suppressed. If a clearance acknowledgment is not received after a pre-determined period of time, an 'unacknowledged clearance' task prompt is automatically displayed.

Background: (Non-Sector) — Some downlinked advisories, such as weather alerts and NOTAMs, are routed to and acknowledged by the NAS-WIS rather than the sector, and then distributed by the NAS-WIS per Task 1.1.3.

Responsibility — **Tactical controller(s).**

Sector Information — Automatically displayed: Alert of message arrival, message content, emergency discriminator, pilot-requested input selection option, suppression of unacknowledged clearance indicator upon receipt of acknowledgment, 'unacknowledged clearance' task prompt.

1.3.4 Receive pilot-initiated radio calls.

Task Objective — Maintain awareness of user requests, advisories, and emergency notifications, and ensure the flight's timely acknowledgment of clearances (whether issued via datalink or radio).

Background — Current radio communication methods are maintained.

Responsibility — **Tactical Controller** *(One controller at a multi-controller sector conducts all radio activity).*

Sector Information — Verbal information: Flight ID, request, advisory, and emergency information, clearance acknowledgment

1.4 MAKE CONTROL DECISIONS & PLAN TASK PRIORITIES

As a product of situation monitoring, the controller makes control decisions — and prioritizes the resulting tasking — within the context of the overall traffic situation. A primary objective of this process is to determine a trajectory for each flight (i.e., speed, altitude, heading, etc.) that maintains safety, meets operational objectives, accommodates user preferences, and maximizes the use of self separation. The tasks required to meet these goals consist of 'procedural' tasks such as handoffs and communications transfers, and 'situational' tasks such as headings and interim altitudes to resolve conflicts. However, these classifications do not indicate a task's *criticality*. Instead, controller task priorities are largely a function of timing. For example, a procedural task such as a handoff can be as critical as an interim altitude to resolve a conflict, since a neglected handoff may *cause* a conflict.

To aid in identifying and prioritizing these actions, system-generated task prompts draw attention to uncompleted procedural tasks such as unacknowledged datalink clearances, unaccepted handoffs for flights nearing the sector boundary, etc. To direct attention to situational tasks, conflict detection aids identify conflicting flights and provide resolutions. The controller also performs trial planning to receive similar information for mentally generated or pilot-requested control-action options. TM DSSs, such as arrival sequencing and spacing aids, provide situational control-action advisories that optimize traffic flows. Finally, these tools — in conjunction with enhanced information-sharing between the NAS, UOC, and flight deck — allow increased accommodation of user preferences and self separation. The following tasks describe the controller/automation interaction in the decision making process.

1.4.1 Assure air safety.

Task Objective — Make decisions that will avoid/resolve conflicts.

Background — The trajectory modeling that is used for automatic conflict detection and on-request trial planning is based on aircraft performance and weight, user operating characteristics, atmospheric conditions, applicable procedures, and user-preferences/pilot-intent. The resulting probes (either automatic or on-request) check for aircraft, SUA, terrain, and weather conflicts. These capabilities ease cognitive workload by augmenting the controller's mental trajectory analysis of specific flights and traffic pairs.

- User-specific models calculate aircraft performance as a function of the flight's current weight and prevailing atmospheric conditions. Current weight is acquired automatically via NAS-WIS/Datalink. Wind, temperature, and pressure aloft are acquired via NWS/NAS-WIS, including real time reports from aircraft. Procedural trajectory requirements (i.e., LOA-required altitude profiles, etc.) are sector-defined. User operating characteristics are determined through detailed analysis of historical flight object data. User preferences for all flights, and self-separation pilot-intent information, is input to the NAS automatically via NAS-WIS/Datalink.
- Since they involve trajectory modeling against large and stationary/slow-moving areas, SUA, terrain, and weather conflict probes are provided over a greater look-ahead time than is feasible for aircraft conflicts. Controllers are required to resolve SUA and terrain conflicts, and to use weather conflict information to assist the pilot in avoiding severe weather.
- Automatic conflict detection is provided at all sectors to warn of conflicting traffic and propose resolution options. The controller mentally analyzes the trajectories of the specified flights and selects the most advantageous option. This reduces cognitive workload by allowing the controller to perform less complex mental trajectory analysis of the rest of the traffic population that is considered problem-free by the system.
- On-request trial planning is provided at selected sectors to test mentally-generated or pilot-requested control actions for aircraft, SUA, terrain, and weather conflicts. Simple inputs and succinct system responses make trial planning feasible at a single-controller sector under high traffic volume and complexity. After executing a trial-planned action that is considered problem-free by the system, the controller is generally able to perform less complex mental trajectory analysis of the resulting traffic interactions.

Responsibility — **Automation:** Conflict detection & generation of resolution options. **Tactical Controller(s):** Near-term conflict resolution (e.g., aircraft, SUA, terrain, and weather), including all required coordination. **Supervisor and/or TM:** Long-range SUA, terrain, and weather conflict resolution.

Sector Information

- Automatically displayed: Near-term conflict warnings.
- On-request: Trial plan results, automatic and trial planned conflict description, conflict resolution options, input selection options for the selected resolution.

1.4.2 Meet procedural requirements.

Task Objective — Determine the tasks and timing required to implement procedurally required actions.

Background — Each flight's route, type, equipage, and destination define many procedurally-required tasks, based on LOAs and facility procedures. These actions include speed and altitude restrictions, handoffs, communications transfers, etc. Since high traffic volume and complexity in 2005 increases the difficulty of tracking the status of these tasks for each flight, the system provides prompts that draw attention to tasks that are both predictably required and objectively time-constrained. Examples of the available task prompts include such cases as:

- A flight that is not handed off is approaching a point from which boundary penetration cannot be avoided.
- A handed-off flight is approaching the boundary, and the communications transfer has not been completed.
- A datalink clearance has remained unacknowledged for a pre-determined period of time.
- A flight has reached a point at which a procedurally required control action must be implemented in order to meet applicable restrictions (i.e., a prompt for the top of an LOA-required descent).

Responsibility — **Tactical Controller(s).** Definition of procedurally required clearances and coordination.

Sector Information — Automatically displayed: Call sign, route/destination, type, equipage, and task prompts.

1.4.3 Conform to TM initiatives.

Task Objective — Determine the control actions and timing required to implement TM initiatives.

Background — TMs use projections of arrival and departure demand to develop TM initiatives and strategies. Traffic loading at specified arrival and departure fixes are provided by TM DSSs. Fast-time simulations are available to evaluate TM options. CDM between the TM and UOC facilitates development of user-preferred route structures, and allows a limited degree of user-preferred traffic sequencing. The initiatives developed with these tools and capabilities are generally communicated to controllers via TM DSS advisories.

- TM arrival flow initiatives are implemented in accordance with flight-specific control action advisories generated by TM sequencing and spacing aids. Arrival controllers utilize these speed, altitude and heading advisories to reduce workload and to optimize the arrival flow. Task prompts are available for all such advisories that are objectively time-constrained.
- TM departure flow initiatives are facilitated by accurate departure time estimates, and implemented through advisories generated by departure sequencing aids. This system-assisted departure staging optimizes the departure flow (including the integration of departures from satellite airports), and simplifies the coordination between the surface and departure controllers.
- The system alerts TM to long-range conflicts. TM initiatives to resolve these conflicts are implemented by sectors that lie well upstream of the predicted event. Controllers are generally apprised of the required actions through silent coordination with the TM. Task prompts are available for all such control actions that are objectively time-constrained.
- Sector overloads are detected by traffic load information produced by TM DSSs. This information consists primarily of traffic counts as a function of time (i.e., flow rates) at specified departure and arrival fixes. Overloads are prevented by de-combining sectors, altering sector boundaries, rerouting flights, or implementing ground delays. Traffic load information is provided to the TM and Supervisor, and the resulting plans are communicated to controllers either verbally or via sector displays for implementation.

Responsibility — **Tactical Controller(s):** TM initiative implementation. **TM:** TM initiative definition.

Sector Information

- Automatically displayed: TM DSS advisories (heading, altitude, speed, etc.), and control action task prompts.
- On-request: Traffic loading at relevant waypoints.

1.4.4 Accommodate Free Flight.

Task Objective — Make decisions that will either accommodate user-preferred trajectories, or minimize restrictions.

Background — The objective of Free Flight is to allow greater access to user-preferred trajectories, while imposing as few restrictions as possible. Fully unrestricted Free Flight allows users to depart on schedule, and then to operate on optimal altitude profiles and routes. However, departure times are affected by taxi-way and runway availability, and by the staging of multiple flights from multiple airports over the applicable departure waypoints. Optimal routes extend as close as feasible to the departure and arrival airports, while the routes themselves are generally defined by winds aloft. Optimal altitude profiles are characterized by uninterrupted climb to cruising altitude, an optimum top-of-descent, and uninterrupted descent to the runway.

- On-time departures are facilitated by surface management tools that improve the movement of flights from ramps to runways. These tools also manipulate actual departure times for optimum airborne traffic flow over the departure waypoints, with minimum overall departure delay. The system integrates arrival and departure activities at all airports within a terminal complex. Predicted departure times and flight-specific delay information are distributed to all relevant sectors.

- Early entry of flights to their preferred routes is facilitated by improved staging over the departure waypoints. This extension of preferred routes closer in to the departure airport requires increased ADCON airspace flexibility. However, since objectively-defined optimal routes between given geographic regions are used by all operators, the system's reliable and accessible wind predictions tend to homogenize the Free Flight route mix. Initial route requests are filed by the UOC, and appropriate route structuring is coordinated with national and facility traffic managers as required.
- Climbs to altitude are calculated based on aircraft performance, current weight, atmospheric conditions (wind, pressure, and temperature aloft), and user-supplied step-climb data. Using these variables, NAS calculates flight-specific climb profiles for use in conflict probing, and for determining dynamic boundary/shelf locations that minimize coordination for overall traffic flows. Under the current system, only the final requested altitude is available from flight plan data. In 2005, 'next requested altitude' data is distributed to the appropriate sectors in a time-sequenced manner. In the ADCON, unrestricted climb to the flight's 'initial requested altitude' is accommodated to the extent possible under prevailing environmental and traffic constraints.
- The latest possible egress from Free Flight routes is facilitated by improved arrival sequencing and spacing tools, thus extending preferred routes closer in to the destination airport. Speed control and vectoring for spacing are minimized prior to egress from the preferred route.
- Upon a flight's egress from Free Flight routings, the controllers' attempts to accommodate optimal altitude profiles continue to the runway. The latest possible tops-of-descent are calculated by NAS based on aircraft performance and weight, optimum speed in descent, predicted length of route to the runway (based on traffic considerations), and winds aloft. These calculations are used for automatic conflict probes and (at sectors equipped with the capability) on-request trial planning. These tools increase the opportunities to eliminate speed and altitude restrictions on a per flight basis. At the appropriate time, the descent is automatically trial-planned and then distributed to the relevant sector as a descent advisory. While uninterrupted descent to the runway remains the goal, interim descent altitudes based on the trial plan are distributed to the controller as required. Trial planning then continues automatically, providing the controller with 'next available altitude' data as the flight progresses. Descent profile data are also used to determine dynamic boundary locations that minimize coordination for overall traffic flows.

Responsibility — **Tactical Controller(s).**

Sector Information — Automatically displayed or on-request:

- Departures: Call sign, initial assigned altitude and crossing restrictions, initial requested altitude, initial assigned heading, departure waypoint, user-preferred route entry point.
- Arrivals: Call sign, destination, assigned runway, preferred-route egress point, top-of-descent point and/or time, TM DSS speed and heading advisories, initial trial planned descent altitude (either interim or final), subsequent interim/final descent altitudes (automatically provided as required).
- Overflights: Call sign, user-preferred route and altitude, trajectory revisions per automatic conflict detection.

1.4.5 Maximize the use of pilot self-separation.

Task Objective — Make decisions to maximize the usage of self separation, in order to increase airspace efficiency.

Background — CDTI extends the benefits of visual separation to all-weather operations. This use of pilot-separation improves airspace efficiency by allowing more timely and precise aircraft maneuvering and speed control, and, when used, it eliminates repetitive controller tasks such as speed matching. CDTI-based self-separation is driven by aircraft equipage, and is implemented by as yet undefined procedures and separation minima. In general, that procedural environment will require the imposition of lateral and vertical deviation limits by the controller, airspace-sensitive conformance checking by the system, and pilot intent information from the flight deck. The use of self-separation requires the concurrence of both controller and pilot, but may be requested by either party. Pilots are cleared for self-separation between their flight and a single opposing flight identified by the controller. The following examples illustrate the types of situations in which self-separation might be used:

- Departures, arrivals, and overflights may perform stationkeeping within their respective traffic flows.
- Overflights and departures may overtake a leading flight (within their respective traffic flows) while maintaining vertical separation.
- Overflights and departures may maneuver laterally to overtake a leading flight (within their respective traffic flows) while maintaining or climbing through that flight's altitude.
- Overflights and departures may separate themselves from a flight in an interacting traffic flow.

Responsibility — Flight crew and controller responsibilities will be defined based on the procedural environment.

Sector Information

- Automatically displayed: Call sign, aircraft equipage, self-separation status, self separation deviation limits, event prompts for aircraft conformance and airspace violation.
- On-request: Collated list of call signs of associated self-separating flights.

1.4.6 Balance overall delay.

Task Objective — When making control decisions, consider the amount of delay each flight has already absorbed.

Background — The system provides 'cumulative delay' information that quantifies the total delay a flight absorbs from its ready-for-pushback time to its actual arrival time. TM DSSs use this information as one variable in the determination of traffic flow sequences. Cumulative delay data is also available for output on the FIP, which enables (but does not require) controllers to:

- Allocate discretionary tasktime to coordinate expedited trajectories for flights that have absorbed delay, rather than for flights that have not been delayed.
- Use cumulative delay as a 'tie-breaker' to determine traffic sequences.

Responsibility — **Tactical Controller(s)**

Sector Information — Automatically displayed or on-request: Cumulative delay.

2.0 ADCON SECTOR ENTRY

The tasks discussed above provide controllers with overall situation awareness, and allow the development of a prioritized task queue. The balance of this module assumes that the controller's task queue is implemented as flights are processed through the sector in two stages, i.e., sector entry and transit. The entry phase begins with receipt of a FIP, and ends when the flight enters the sector. During this time, controllers incorporate the data into their mental picture of the traffic situation, and manage the entry of the flight into the sector. As discussed below, the entry phase requires the controller to assess the impact of the approaching flight, either receive a departing flight or respond to the handoff from an another sector, and establish communications with the flight.

2.1 ASSESS THE IMPACT OF THE APPROACHING FLIGHT

The following tasks describe the controllers' assimilation of information on the pending flight into their mental picture of the traffic situation. Each flight's FIP is posted at a pre-determined time prior to the flight's airspace entry, or when a realistic departure time is known. Upon delivery, the data is reviewed to determine the tasks the flight will generate. DSSs identify problems involving the flight, and allow them to be resolved through early coordination with the upstream controller.

2.1.1 Receive and review information on the approaching flight.

Task Objective — Assess the flight's newly-arrived data to determine general task requirements.

Background — Flight information is posted prior to the arrival of the flight at the sector. To determine the tasks the flight will generate, controllers use basic flight object data that implicitly indicates such tasking as procedurally required descents for arrivals. In addition, system-generated cues explicitly indicate conflicts, and task requirements such as the need to issue preferential arrival routes, or execution of TM initiatives.

(a) Departure from a primary or satellite airport.

Background — The FIP is posted as soon as an accurate departure-time prediction is computed.

Responsibility — **Tactical Controller(s).**

Sector Information

- Automatically displayed: Call sign, departure point, predicted departure time, in-sector conflict warning.
- Automatically displayed or on-request: Aircraft type and equipage, departure runway, initial heading, initial assigned altitude, initial requested altitude, departure delay, departure waypoint and route, DSS advisories, conflict and resolution data, self-separation indicator, self-separation deviation limits.

(b) Airborne flight (inter- or intra-facility).

Background — Flight information on an airborne flight is posted at an adapted time prior to sector entry.

Responsibility — **Tactical Controller(s).**

Sector Information

- Automatically displayed: Call sign, predicted sector-entry time, in-sector conflict warning.
- Automatically displayed or on-request: Aircraft type and equipage, present position, route and destination, current and assigned heading, altitude, and speed (IAS and Mach), groundspeed, DSS advisories, flight condition indicator (emergency, hijack, communications failure, etc.), conflict and resolution data, pilot self-separation indicator, self-separation deviation limits, self-separation pilot-intent, coordination information (sector possessing the track, communicating sector, level of control requested/received, preplanned actions by the controlling sector, identities of sectors observing the flight, etc.).

2.1.2 Perform early coordination either to resolve conflicts or to expedite traffic.

Task Objective — Facilitate traffic safety and efficiency through improved coordination prior to sector entry.

(a) Coordinate with the surface controller.

Background (Sector)— As occurs under the current system, coordination with the surface controller in 2005 is performed by controllers, supervisors, and TM. The effectiveness of this coordination is enhanced through improved information, and because of the efficiencies provided by silent coordination.

- Eliminate Restrictions: Under the current system, pre-defined departure restrictions are often left in place simply because of a lack of timely information. In addition, since actual departure times are not accurately known in advance, restrictions are often left in place as 'paper stops' to positively separate the departing flight from other traffic. In 2005, accurately predicted departure times are calculated prior to the event, and pre-departure conflict detection and trial planning are available to the ADCON departure controller. When sector workload allows it, the controller is therefore able to trial plan the elimination of restrictions on individual flights. If elimination is feasible, the controller may force the output of the desired (e.g., unrestricted) flight parameters on the surface controller's displays to indicate an ADCON request for those conditions. The surface controller then re-clears the flight and shows the revised conditions as the current clearance status of the flight.
- Impose Restrictions: Pre-departure conflict probes detect problems well before the flight departs, and provide resolution options. Upon selection of an option by the ADCON controller, the required flight parameters are automatically displayed to the surface controller, who issues the appropriate clearances.

Responsibility — **Tactical Controller(s), Supervisor, TM**.

Sector Information

- Automatically displayed: Call sign, automatic conflict warning, control instruction to the surface controller, revised clearance status as activated by the surface controller.
- On-request: Trial plan result, conflicts (automatically detected or trial planned), conflict resolution options.

(b) Coordinate with other sectors (ADCON or ECON).

Background — Silent coordination may be used to 1) resolve conflicts well before the flight enters the sector, and 2) to arrange the implementation of expedited trajectories by an upstream sector.

- Conflict Resolution. The system reports conflicts and resolution options to the sector in which the conflicts will occur. If action prior to airspace entry is desirable, coordination is initiated to have that action implemented by the upstream ADCON or ECON sector. To execute this coordination silently, the initiating controller forces the output of the appropriate control instruction on the upstream controller's display to indicate the conditions the flight must meet prior to sector-entry.
- Expedited Trajectory. The controller may silently coordinate with an upstream sector to deliver an expedited routing or a more desirable altitude profile to a flight. To do so, the controller may either 1) force the output of the appropriate control instruction on the upstream controller's display to indicate the conditions the flight must meet prior to sector-entry, or 2) using the preplanning function, force the appropriate preplanned control instruction on the upstream sector displays in the form of a request which the upstream controller may either accept or reject.

Responsibility — **Tactical Controller(s):** Near-term coordination. **Supervisor and/or TM:** Long-range coordination.

Sector Information

- Automatically displayed: Call sign, conflict warning, control instruction issued to upstream sector.
- On-request: Conflict description, resolution options.

2.2 RECEIVE THE APPROACHING FLIGHT

ADCON sectors receive handoffs on flights from other sectors, and they locate and initiate ATC services on departures and pop-ups. The current tasking to radar identify departures and pop-ups is eliminated by improved surveillance equipment and processing in 2005. Communications with flights received from another sector are generally established after handoff, and prior to sector entry. Communications with departures are established shortly after take-off. Communications with datalink-equipped flights are transferred to the receiving sector as a result of a manual computer input by the transferring controller.

2.2.1 Initiate ATC services for departures and pop-ups.

Task Objective — Locate a departure or pop-up, and respond to the flight's requests/requirements.

Background — Advanced aircraft surveillance equipment and ground-based surveillance processes utilize permanent, discrete signaling by individual aircraft. This allows each appropriately equipped aircraft on the ramp or in covered airspace to be automatically identified and continuously tracked by the system. As a result, current controller tasking involved in radar-identifying departures and pop-ups is fully automated. At the first sector to work the flight, the controller locates the flight via surveillance data and initiates services, as follows.

- Targets and full data blocks on IFR departures are first displayed to the departure controller when the aircraft exceeds a pre-defined altitude AGL.
- Situation data on non-flight-followed flights are available per controller-selectable altitude filters. Associated with the target are 1) limited data blocks that display a flight status indicator and altitude readout, and 2) a sector-defined full data block and FIP which may be displayed on request.
- Full data blocks and FIPs on non-flight-followed VFR flights that wish to receive ATC services are automatically displayed based on the pilot-selected setting of the airborne equipment. (Prior to the pilot's selection of this setting, the flight is available for display as a target and limited data block, per controller-selectable altitude filters.) These flights may either request VFR flight following or an IFR flight plan. In either case, a filed flight profile for the flight is associated with the track.

Responsibility — **Automation:** Surveillance identification, and altitude verification. **Tactical Controller(s):** Awareness of the flight's location and initiation of ATC services.

Sector Information

- IFR and flight-followed VFR flights:
  - Automatically displayed: Target, full data block, and FIP.
  - On-request: Track projections (vector line, halo, route readout, etc.).
- Non-flight-followed VFR flights:
  - Automatically displayed, per altitude filters: Target, VFR indicator, and current altitude.
  - On-request: Full data block, track projections, and FIP.

2.2.2 Receive a flight from another sector.

(a) Observe handoff notification.

Task Objective — Visually assess the immediate impact of the flight's entry into the sector.

Background — NAS determines which sectors will receive a handoff on the flight, and which sectors will receive a pointout. Handoffs are generally system-initiated at a pre-established time or distance from the sector boundary. Prior to handoff initiation, the flight can be observed via limited data block. Upon handoff initiation, a full data block is displayed and an expanded FIP is output per sector-defined requirements.

Responsibility **— Tactical Controller(s).**

Sector Information

- Automatically displayed: Target, full data block, handoff indication, and FIP.
- On-request: Track projections.

(b) Plan for timely handoff acceptance or alternative action.

Task Objective — Maintain airspace integrity with minimal coordination.

Background — As the flight approaches the protected airspace of the receiving sector in handoff status, trajectory modeling determines the point at which airspace penetration is unavoidable. An indicator is provided at the initiating and receiving sectors that prompts the controllers to take the appropriate action when a flight approaches this point without the handoff being completed.

Responsibility –**Tactical Controller(s).**

Sector Information — Automatically displayed: 'Uncompleted-handoff' task prompt.

(c) Request control, if required, and accept or reject handoff.

Task Objectives — 1) Gain the authority to implement control actions prior to the flight's entry into the sector, if required. 2) Indicate approval/disapproval for the flight's entry into the sector.

Background

- Handoff Acceptance: Situations often require the receiving sector to control a flight in the transferring sector. An automated method to negotiate control during the handoff transaction is provided, as follows.
  - The transferring sector may preemptively release various levels of control (i.e., complete control, control for turns, etc.) as part of a manually initiated handoff.
  - The receiving sector may request various levels of control as part of the handoff acceptance.
  - A request by the receiving sector, or a preemptive release by the transferring sector, can either be accepted or counter-offered by the other sector as part of the continuing handoff transaction. At any point in this dialogue, an acceptance input by the responding sector completes the handoff.

   – Handoff status and the level of control released to the receiving sector are output on the displays of all sectors involved in the handling of the flight.

- Handoff Rejection. The receiving sector may reject the handoff if agreement is not reached in the control negotiation discussed above, or for unrelated reasons. In either case, a handoff rejection suppresses the flight's data at the receiving sector, and sends a notification of handoff rejection to the transferring sector.

<u>Responsibility</u> — **Tactical Controller(s)**

<u>Sector Information</u> — Automatically displayed: Indication of handoff status, level of control preemptively released by the transferring sector, level of control requested by receiving sector, indication of handoff acceptance and level of control ultimately released, notification to the transferring sector of handoff rejection.

(d) Enable Automatic Handoff Acceptance *(Controller-Selectable Capability*).

Task Objective — Maintain awareness of arriving traffic.

Background — Sector controllers can enable a function which automatically accepts handoffs on flights that are projected to be conflict-free across the sector. This function can be enabled/disabled at will, based on the needs of the Tactical Controller(s). If this function is disabled, handoffs are processed according to tasks (1) through (3) above. When enabled, the function accepts the handoff for each conflict-free flight at its penetration avoidance point. Handoffs on flights for which a conflict is predicted must be accepted manually. The data objects for flights with a projected in-sector conflict are emphasized to indicate the need for manual handoff acceptance. Prior to automatic handoff acceptance, the receiving controller can manually intervene, on a per flight basis, to reject the handoff or to initiate a request for control.

Responsibility — **Tactical Controller(s):** Accountability for automatically accepted handoffs.

Sector Information — Automatically displayed: Auto-Accept “Enabled” status, target, data block, notification of requirement for manual acceptance.

(e) Receive initial datalink contact.

Task Objectives — Verify datalink messaging authority (connectivity) with the flight, and verify the flight is tuned to the voice frequency.

Background — The transferring surface or sector controller enters a NAS/datalink message which 1) instructs the flight to change voice-frequencies and 2) transfers datalink messaging authority to the receiving sector. The uplinked message either directs the flight to contact or monitor the receiving sector, and specifies the new voice frequency. Upon receiving the message, the flight crew sets that frequency on their radio and makes the initial radio call if so directed. The flight’s new frequency selection is automatically downlinked to the NAS. If the flight resets to an incorrect frequency, the datalink instruction is automatically sent again. When the flight’s frequency is set correctly, the sector corresponding to that setting is identified as the communicating sector. The identity of the sector in contact with the flight is distributed to all sectors.

Responsibility — **Tactical Controller(s).**

Sector Information — Automatically displayed: Identity of the communicating sector, and radio ‘monitor’ status (receiving sector only).

(f) Receive initial call from a datalink-equipped flight.

Task Objectives — Verify the flight is on frequency.

Background — Those flights which are directed to contact the receiving sector will report on frequency, and receive verbal acknowledgment from the controller. Current and assigned altitudes are not reported by the flight.

Responsibility — The **Tactical Controller** responsible for radio activity.

Sector Information — Verbal information: Call sign, and ‘on-frequency’ report.

Note: The procedure for initial radio calls by non-datalink-equipped flights is generally unchanged from current practices, except that the receiving controller enters a NAS message to indicate the flight is on frequency. After the communications transfer is completed for any flight, the receiving sector assures separation from traffic in the transferring sector by exercising only the level of control granted by that sector while the flight is in that airspace. The next section describes the processing of flights after they have entered the sector’s airspace.

3.0 ADCON SECTOR TRANSIT

The transit phase of a flight begins when the sector is communicating with the flight and has authority to control it. This phase ends when the flight exits the sector's airspace. During the intervening period, the controller performs the tasks required to implement control decisions, transfer control of the flight to the downstream sector or tower, transfer communications, and monitor the flight until it is beyond the boundary and clear of the sector's other traffic.

3.1 IMPLEMENT CONTROL DECISIONS

As discussed earlier, controllers make flight-specific decisions within the context of the overall traffic situation. The objectives of these decisions are to detect and resolve conflicts, accomplish procedural requirements, execute TM initiatives, and accommodate user-preferences and self separation. The flight-specific tasks generated by these decisions primarily involve inter-sector coordination, and the issuance of clearances and advisories.

3.1.1 Perform inter-sector coordination.

Task Objective — Receive/forward control information and pilot requests, coordinate to gain approval for a flight's current trajectory, and coordinate to gain approval for changing a flight's trajectory.
Background — Most coordination is performed silently, and the results are available for display at all sectors involved in handling the flight. Silent coordination can be executed by either of the sector's Tactical Controllers. Verbal coordination is only used to forward atypical information or in instances when silent coordination is not practical.

- Pilot requests and basic control information are forwarded via data blocks and FIPs. To ensure that the formats and filters in use at the receiving sector do not suppress information a controller wishes to forward, specific control information can be forced on the receiving sector's displays.
- Under the current system, controllers manually initiate pointouts to gain approval for a flight to enter the affected sector along its current trajectory, or to coordinate a change in the flight's trajectory that will affect the other sector. In 2005, pointouts are conducted as follows:
  - Pointouts to gain approval for the flight's current trajectory are automatically initiated.
  - If a trajectory change does not require pre-approval, the controller enters the revised trajectory, and the system automatically initiates any required pointouts.
  - Pointouts to coordinate a change in a flight's trajectory continue to be manually initiated. The controller first utilizes the preplanning capability to display the desired control actions on the flight's data block and FIP, and then initiates the pointout.
  - Automatic and manually initiated pointouts force the flight's data block and FIP on the displays of the appropriate sector(s). The forced information includes the preplanned actions of the initiating controller.
  - The receiving controller utilizes the pointout response capability to approve or disapprove the pointout. This capability allows conditional approval for airspace entry (i.e., at or above a specified altitude, east of a specified fix, etc.). It also provides an 'Accept Handoff' option to indicate that airspace entry is approved, and that the receiving sector will work the flight. The 'Accept Handoff' option provides the capability for control negotiations as discussed earlier.
- Coordination on a flight that is not within the affected sector's geographical area of interest is performed using a manually initiated FIP pointout in which only the information posting of the flight is forced on the display of the receiving sector. The coordination process is the same as the full pointout, including the preplanning function and all of the response capabilities except for the 'Accept Handoff' option.
- Other forms of inter-sector coordination discussed earlier are:
  - Conflict resolutions prior to airspace entry (reference Task 2.1.2).
  - Control negotiations conducted on handoff (reference Task 2.2.2c).

Responsibility — **Tactical Controller(s):** Near-term coordination. **Supervisor/TM**: Long-range coordination.
Sector Information — Automatically displayed: Forced control information & pilot requests, pointed out datablocks and FIPs (including preplanned actions by the initiating controller), pointout response (approved, approval conditions, disapproved, 'Accept Handoff').

3.1.2 Issue clearances.

Task Objective — Manipulate flight trajectories (heading/route, altitude, speed, etc.).

Background — Most clearances are intended to implement changes in the flight's trajectory. Upon acknowledgment by the flight, each clearance becomes the flight's current trajectory information that is automatically distributed to all sectors observing the flight. Both radio and datalink are used with equal utility to issue clearances.[10] One of the sector's Tactical Controllers issues clearances via radio or datalink, and directs the datalink issuance of clearances by the other Tactical Controller. Together, the sector's radio and datalink messaging allows an increase in the number of clearances that can be implemented per unit time.

- All trajectory information is entered into the NAS using the applicable computer message.
- For clearances issued via datalink, the input of the NAS message triggers the automatic composition of the appropriate datalink message, based on the flight ID, message type, and input value of the NAS message. The composed datalink message is displayed to the controller for review, edited if necessary, and then transmitted. Upon transmission, the new control information is indicated on the flight's data objects as an unacknowledged datalink clearance. While awaiting acknowledgment of the clearance, the controller is free to perform other tasks. When acknowledgment is received, the information is displayed as the current trajectory information for the flight, and the clearance task cycle is complete. If no acknowledgment is received after a pre-determined time, an 'unacknowledged clearance' task prompt is presented to the controller, who then takes the appropriate action to assure aircraft compliance.
- For clearances issued via radio, the controller enters the NAS message during clearance issuance and readback. Entry of the NAS message immediately updates the current trajectory information on the flight.

Responsibility — **One Tactical Controller:** Radio clearances. **Either Tactical Controller:** Datalink clearances.

Sector Information

- Input information: Datalink activation, flight ID, NAS message type, input data value(s), datalink message editing, datalink 'transmit' action.
- Automatically displayed information: Current trajectory information, composed datalink message (for review and editing), cleared but unacknowledged trajectory information with 'unacknowledged clearance' indicator, 'unacknowledged clearance' task prompt.

3.1.3 Provide IFR and VFR advisories and on-request information updates.

Task Objective — Provide information that promotes air safety and/or user planning (i.e., traffic advisories, PIREPs, NOTAMs, NAS infrastructure outage reports, etc.).

Background — Traffic, weather, SUA, terrain, and infrastructure advisories are provided to all IFR flights. In addition, these advisories are provided to VFR flights on an as-able basis, at the discretion of the controller.

- Under the current system, traffic advisories are verbiage-intensive, and the same advisory is often quoted numerous times to a flight until the traffic is sighted. In the transitional environment of 2005, the traffic's equipage mixture necessitates a variety of techniques for issuing traffic advisories.
  - No advisory is required for a CDTI-equipped flight if the opposing traffic is equipped for CDTI detection and full-data CDTI display.
  - A single advisory is required for a CDTI-equipped flight if the opposing traffic is equipped for limited-data CDTI display. These advisories are manually issued via datalink, using system-assisted message composition.
  - Traditional advisories are required for non-datalink or non-CDTI-equipped flights.
- Flights with access to NAS-WIS/Datalink automatically receive information such as altimeter settings, ATIS, PIREPs, NOTAMs, AIRMETs, SIGMETs, NAS infrastructure outage reports, etc.
- The system automatically provides a terrain alert according to either the assigned or reported altitude of the flight. All alerts are output at the sector in the form of an event prompt. Non-datalink-equipped flights receive the alert from the controller via radio. Datalink-equipped flights receive the alert automatically.
- Weather, SUA, and infrastructure information updates are provided upon request. If time does not permit the controller to fulfill a request, the flight may be cleared to contact the Flight Advisory Services in-flight advisor for the information update (reference Section C, Part 2).

Responsibility — **One Tactical Controller:** Radio advisories: **Either Tactical Controller:** Manually initiated datalink advisories. **Automation (NAS-WIS and Datalink):** Altimeter settings, terrain alerts, ATIS, PIREPs, NOTAMs, etc.

Sector Information — Automatically displayed or-request: Call sign, applicable traffic, altimeter settings, PIREPs, NOTAMs, AIRMETs, SIGMETs, SUA status, weather, NAS infrastructure status and schedule.

[10] The tactical usage of datalink as required by this task assumes an very rapid uplink/downlink capability.

3.2 TRANSITION THE FLIGHT FROM THE SECTOR

ADCON controllers transition flights out of their sector by either transferring the flight to the surface controller, terminating ATC services upon IFR cancellation by the pilot, or by handing off to another sector. (The task description for transferring the flight to the surface controller will be developed upon completion of the Surface Control Working Group. The tasks involved in terminating ATC services are not affected by automation, and will continue to be performed in accordance with current practices.)

3.2.1 Transfer the flight to the surface controller.

TBD pending completion of Surface Control Working Group

3.2.2 Transfer the flight to the next sector.

(a) Ensure timely handoff initiation.

Task Objective — Maintain airspace integrity by ensuring that handoff notification is made to the downstream sector well before the flight crosses the boundary.
Background — The timing parameter for handoff initiation provides the receiving controller with sufficient time to analyze the traffic situation, conduct appropriate planning, and perform any necessary coordination. The transferring sector is responsible for initiating the handoff, or for ensuring that automatic initiation occurs.
Responsibility — **Tactical Controller(s).**
Information — Automatically displayed information: Map data, track position, handoff notification.

(b) Release control to downstream sector if requested.

Control negotiations on handoff are discussed in Task 2.2.2c.

(c) Ensure timely handoff acceptance or rejection.

Task Objective — Ensure the flight is approved to enter the next sector, or take appropriate alternative action.
Background — The system provides an 'uncompleted handoff' task prompt to indicate that a flight in handoff status is approaching its penetration avoidance point. If the handoff or other coordination is not completed at that point, the transferring sector must retract the handoff and divert the flight away from the boundary.
Responsibility — **Tactical Controller(s).**
Information — Automatically displayed information: Handoff acceptance indicator, handoff rejection indicator, 'uncompleted handoff' task prompt at both sectors.

(d) Issue communications change to a datalink-equipped flight.

Communications are transferred when the traffic situation requires no further information exchange with the flight. The transfer process is discussed in Task 2.2.2e.

(e) Suppress the flight's FIP and indicate non-communicating status on the situation display.

Task Objective — 1) Minimize screen clutter by suppressing the flight's FIP. 2) Indicate on the situation display that problem resolutions requiring communications with the flight are no longer feasible.
Background — Upon the transfer of communications, the FIP is automatically suppressed. The data block remains displayed until after the flight exits the airspace. The identity of the communicating sector is shown in the data block. Other indicators of non-communicating status are also available, such as a dimmed data block.
Responsibility — **Automation.**
Information — Non-communicating status

(f) Suppress the flight's data block.

Task Objective — Minimize screen clutter by suppressing the data block when the flight can no longer affect other traffic in the sector, regardless of any aircraft non-conformance.
Background — Sectors can be defined in automation either to suppress data blocks automatically at a predetermined distance outside the sector's airspace, or for manual suppression by the controller when the flight is outside of the sector's airspace and clear of all other sector traffic.
Responsibility — **Tactical Controller(s) or Automation**.
Information — Map data, track data, distance from the boundary.

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PART 3 — SURFACE CONTROL TASK MODULE (TBD)

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PART 4 — OCEANIC CONTROL TASK MODULE (TBD)

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SECTION B —TRAFFIC MANAGEMENT SERVICES (TBD)

Part 1 — En Route Traffic Management Task Module
Part 2 — Arrival/Departure Traffic Management Task Module
Part 3 — Surface Traffic Management Task Module
Part 4 — Oceanic Traffic Management Task Module
Part 5 — National Traffic Management Task Module

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SECTION C — FLIGHT ADVISORY SERVICES (TBD)

Part 1 — Pre-Flight Advisory Task Module
Part 2 — In-Flight Advisory Task Module
Part 3 — Emergency Advisory Task Module
Part 4 — External Support Task Module
Part 5 — ATS Support Task Module

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SECTION D — INFRASTRUCTURE MANAGEMENT SERVICES (TBD)

Part 1 — System Operations Center Task Module
Part 2 — Work Center Task Module

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SECTION E — OPERATIONAL SCENARIOS

This Section presents operational scenarios to illustrate the roles of the various FAA and user personnel in the operation of the air traffic system. At this stage in the development of this document, these scenarios are directed at AT and AF activities related to En Route and Arrival/Departure operations. As meetings with the concept development team continue, other scenarios will be included to further illustrate system operations in the other operational specialties. The scenarios presented are below are as follows:

Scenario 1 — A Metered Flight In a Low Altitude Arrival Sector, page 55.

Scenario 2 —Boundary Change and Route Structure for SUA Activation, page 57.

Scenario 3 —Boundary Reconfiguration for Workload Distribution, page 59.

Scenario 4 —Free Flight and Self-Separation Within a Departure Flow, page 61.

Scenario 5 — Self-Separation in Low Visibility Approach Conditions, page 63.

Scenario 6 — ADCON Departure Rush, page 65.

Scenario 7 — ADCON Communications Failure (Data and Voice), page 67.

Scenario 8 — Terminal Radar/Beacon Failure page 69.

Scenario 9 — Scheduled Shutdown of LRR Serving Three ECON Facilities, page 71.

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Scenario 1 — A METERED FLIGHT IN A LOW ALTITUDE ARRIVAL SECTOR

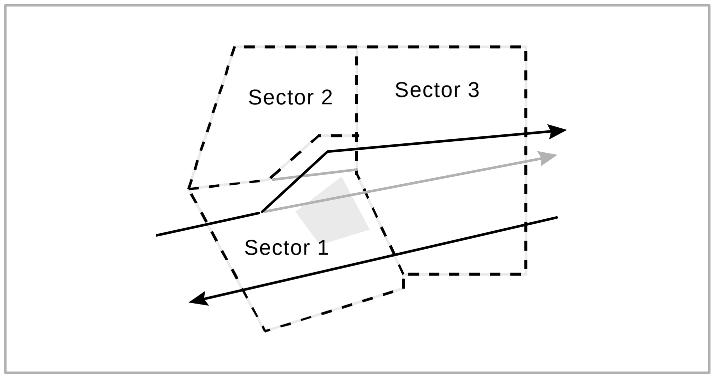
While monitoring arrival traffic load information, the TMC observes that traffic flow modulation will be required for 45 minutes, beginning with XYZ1234. This flight is currently descending in high altitude and being handed off to Sector 1, a low altitude arrival sector. Arrival scheduling information indicates that this flight's entry into ADCON airspace must be delayed by two minutes. Subsequent flights must be delayed by up to eight minutes.

- The TMC implements traffic flow modulation by forcing flight-specific scheduling and delay information on the displays of all sectors that perform arrival traffic flow modulation. This action also activates TFM DSS heading, altitude, and speed advisories for output at the appropriate sectors.
- At Sector 1, the Associate Tactical Controller accepts the handoff on XYZ1234. Shortly thereafter, scheduling and delay information is output on the sector displays, indicating that traffic flow modulation is in effect. The information output at Sector 1 indicates that XYZ1234 must be delayed by two minutes.
- The Sector 1 Tactical Controller observes the location of XYZ1234, and notes the flight's required delay. Based on the flight's location and the magnitude of the required delay, the controller recognizes that vectoring will be required.
- With the flight 15 miles from the lateral confines of the sector, a datalink message is received from XYZ1234 indicating that it is on frequency. Flight information indicates that it is descending to the floor of the high altitude sector, and is on its own navigation direct to the arrival fix. A manual action by either controller implements an uplinked message confirming receipt of the flight's initial contact message.
- With the flight now within the lateral confines of the sector, a control-action timing indicator alerts the controller to issue XYZ1234 a descent and speed clearance, per LOA crossing restrictions at the arrival fix. A system-generated input selection option is displayed with which the controller can enter the LOA-required altitude and speed. Availability of this option indicates that the resulting trajectory is conflict free. After assessing the impact of this control action, the Tactical Controller 1) activates the input selection option, 2) observes the entry of the data in the flight's data objects, 3) reviews the automatically composed datalink text, and 4) transmits the datalink message. Upon transmission, an "unacknowledged datalink clearance" indicator appears in the flight's data objects.
- Shortly thereafter, a clearance acknowledgment is downlinked by the flight crew, and the unacknowledged clearance indicator is removed for the flight's data objects.
- As the flight descends into Sector 1 airspace, a control action timing indicator alerts the controller to a heading advisory generated by TFM decision support systems. A system-generated input selection option is displayed with which the controller can enter the suggested heading. After assessing the impact of this control action, the Tactical Controller 1) activates the input selection option, 2) observes the entry of the data in the flight's data objects, 3) reviews the automatically composed datalink text, and 4) transmits the datalink message. Upon transmission, an "unacknowledged datalink clearance" indicator appears in the flight's data objects.
- Shortly thereafter, a clearance acknowledgment is downlinked by the flight crew, and the unacknowledged clearance indicator is removed for the flight's data objects. The Tactical Controller monitors the flight's compliance on the situation display.
- Several minutes later, a control action timing indicator alerts the controllers to a navigation advisory generated by the TFM DSS, which has calculated that XYZ1234 has incurred its two-minute delay. The navigation advisory suggests the flight be cleared direct the arrival fix, via the global grid system. A system-generated input selection option is displayed with which the controllers can enter the suggested control-action. The Tactical Controller is currently issuing a lengthy route clearance to another flight via radio. With a hand gesture, the Tactical Controller directs the Associate Tactical Controller to issue the control instruction. Thereupon, the Associate Tactical Controller 1) activates the input selection option, 2) observes the entry of the data in the flight's data objects, 3) reviews the automatically composed datalink text, and 4) transmits

the datalink message. Upon transmission, an “unacknowledged datalink clearance” indicator appears in the flight’s data objects.

- A short time later, a clearance acknowledgment is downlinked by the flight crew, and the unacknowledged clearance indicator is removed for the flight’s data objects. The Tactical Controller monitors the flight’s compliance on the situation display.
- With the flight several minutes from the boundary, a handoff is automatically initiated to the ADCON.
- Several minutes later, a timing indicator on the flight’s data objects alerts the controllers that XYZ1234 is approaching the penetration avoidance point, and that the ADCON controller has not yet accepted the handoff. However, before the Associate Tactical Controller can make interphone contact to determine the receiving controller’s intentions, handoff symbologies in the flight’s data objects indicate that the ADCON is requesting control for right turns. The Tactical Controller makes in input granting the request, and the handoff transaction is completed.
- With the handoff completed, and with the flight nearing the boundary, a control action timing indicator alerts the controller to transfer communications to the ADCON. A system-generated input selection option is displayed with which the controller can enter the communications transfer. With no further need to communicate with the flight, the Tactical Controller 1) activates the input selection option, 2) observes the entry of the data in the flight’s data objects, 3) reviews the automatically composed datalink text, and 4) transmits the datalink message. Upon transmission, an “unacknowledged datalink clearance” indicator appears in the flight’s data objects.
- Shortly thereafter, a clearance acknowledgment is downlinked by the flight crew, and the unacknowledged clearance indicator is removed for the flight’s data objects. Datalink messaging capability is automatically transferred to the ADCON sector. Data for XYZ1234 is automatically deleted from the Sector 1 IFID, and the data block on the situation display provides an obvious discriminator to indicate that the flight is no longer communicating with the sector.
- As XYZ1234 enters ADCON airspace, a Sector 1 controller may manually suppresses the data block from the sector’s situation display. *(Note: The system also provides the capability for individual sectors to be defined in automation to automatically suppress the data block when the flight exits the sector airspace.)*

Scenario 2 — BOUNDARY CHANGE AND ROUTE STRUCTURE FOR SUA ACTIVATION



An SUA is fully contained within Sector 1, Area A. The current schedule calls for the SUA to be active for 45 minutes, beginning in two hours. The user organization is requesting immediate activation, and for the SUA to remain active for one hour. A heavy traffic flow is currently operating through the SUA. A standard temporary route structure and boundary configuration are normally utilized while the SUA is active. This route/boundary configuration affects Sector 2 in Area B, and Sector 3 in Area C.

- The military liaison specialist receives the request for the schedule change from the user organization. The user is advised to stand by while the schedule revision is coordinated. The MLSS then advises the Area A Area Coordinator of the request.
- The Area A Area Coordinator enters a trial schedule revision in order to identify aircraft that will conflict with the SUA. Since a standard route resolution is defined, all applicable flights are automatically trial planned on that route, and any resulting aircraft-to-aircraft conflicts are flagged.
- While it is the Area Coordinator's responsibility to approve or disapprove the SUA user organization's request for the airspace, it is the Tactical Controller's responsibility to determine the timing for releasing the airspace. Therefore, the Area A Coordinator electronically forwards the proposed SUA schedule, list of affected flights, and trial plan results to Sector 1. The sector also receives a graphical depiction of the proposed boundary and route structure.
- The Coordinator receives the controller's concurrence for the schedule change and airspace/route reconfiguration, either verbally or through silent coordination. With a traffic flow currently operating through the SUA, the controller indicates the first flight that can be rerouted around the airspace, and the last flight to operate through the SUA. The SUA is therefore available to the user organization at the time the last flight in the current traffic flow exits the airspace.
- The Area A Coordinator electronically forwards the proposed SUA schedule, list of affected flights, trial plan results, and graphical depiction of the boundary and route structure to the Area Coordinators at Areas B and C. After coordinating with their controllers, the Areas B and C Coordinators approve the schedule change and airspace/route reconfiguration, either verbally or through silent coordination.
- The Area A Coordinator implements the route and boundary reconfiguration, and contacts the military liaison specialist to approve the schedule change, beginning at the time the last flight clears the airspace. The liaison specialist updates the SUA schedule. The new schedule is electronically forwarded to the user organization via NWIS. The information is also available to the AOC via the NWIS.
- With the revised schedule activated, the Sector 1 controller receives SUA probe results on the affected flights, with the pre-defined route resolution presented as an input selection option for each flight. The controller activates the input for the affected flights that are currently within Sector 1 airspace, and transmits the datalink clearances.
- Upon activation of the revised schedule, the TMC receives airspace probe alerts on all flights that will conflict with the SUA. Using a global datalink messaging capability, the TMC issues revised route clearances to those flights, some of which are in the upstream En Route facility's airspace.
- The reconfiguration process is completed when the revised route and boundary structure is activated in automation, and when all affected flights have received the appropriate route clearance.

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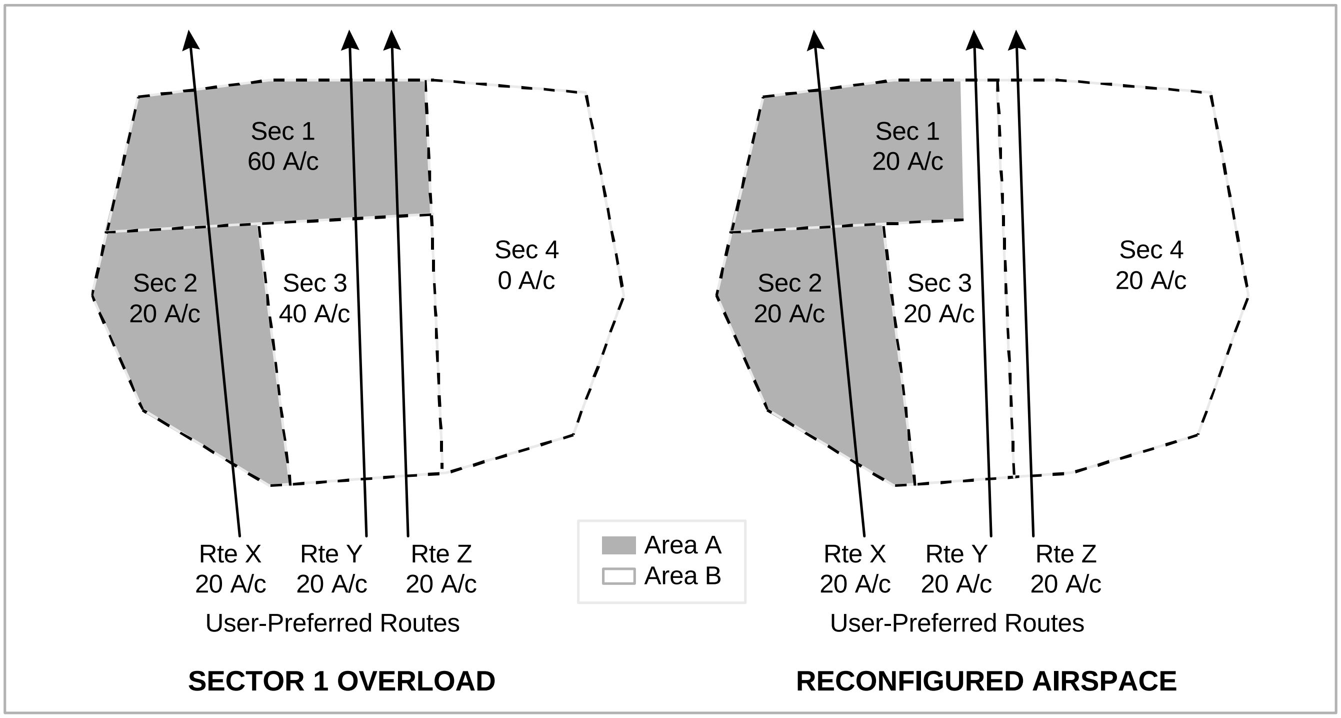
Scenario 3 — BOUNDARY RECONFIGURATION FOR WORKLOAD DISTRIBUTION



Upon completion of a southbound traffic rush, the Area A Coordinator accesses extended density and workload predictions for Area A's high-altitude sectors as they are currently configured. The dynamic density and workload tool indicates that a heavy northbound rush will overload Sector 1 in about an hour.

- To determine the exact nature of the rush, the Coordinator requests predicted traffic counts and track plots for the next two hours. Since Areas A and B routinely collaborate in problem resolution, the Coordinator requests the predicted counts and plots for all high-altitude traffic in both Areas.
- The track plots indicate that Sector 1 will have no flights crossing the traffic flows "Y" and "Z." Therefore, Sector 3 could work those flows to the northern boundary without incurring any significant effect on that sector's traffic volume or complexity. The Area A Coordinator therefore decides to coordinate with Area B for an airspace configuration that will move Sector 1 airspace away from at least traffic flow "Z".
- At the same time, the Area B Coordinator independently determines that the northbound rush will subject Sector 3 to capacity traffic, and that Sector 4 will have no traffic at all during the rush period. After requesting and analyzing predicted track plots for the Area, the Coordinator tentatively plans to move the Sector 3-4 boundary to the west in order to have Sector 4 work traffic flow "Z."
- To initiate inter-area coordination, the Area A Coordinator electronically forwards all relevant information (traffic counts, track plots, and suggested boundary location) to the Area B Coordinator. Together, they determine that Area B can work the "Y" and "Z" flows to the northern boundary, with Sectors 3 and 4 reconfigured to capture one flow each.
- After implementing the boundary change on a trial basis, the Coordinators assess density and workload predictions under the revised configuration, and find that all sectors remain well below capacity for the duration of the rush. The Coordinators electronically forward the proposed boundary configuration, traffic counts, and predicted track plots to the TMC, in order to verify the proposed change does not impact any current TFM planning. In an interphone conference call between the TMC and coordinators, the TMC raises no objection to the proposed change.

- Each Coordinator electronically forwards the traffic information and proposed boundary configuration to their respective sectors, to verify the acceptability of the plan with the controllers. No objections are raised by the controllers. However, Sectors 1 and 3 are each working flights that will no longer be in their airspace after the boundaries are reconfigured. Sector 1 has an eastbound flight that will be in Sector 3's airspace after the change, and Sector 3 has three southbound flights that will be in Sector 4's airspace after the change.
- With the rush arriving at the southern boundary in 30 minutes, the Coordinators plan for immediate implementation of the reconfiguration. Upon activation of the change, the reconfigured boundaries are shown on the map displays at all relevant sectors and facilities. Flight data processing is automatically reprogrammed for updated fix postings.
- With implementation of the change, handoffs are automatically initiated on all flights that have become encompassed by a different sector. Sector 3 takes a pointout on the eastbound flight coming from Sector 1 and hands it off to Sector 4. Sector 4 accepts the handoff on that flight, and on the three southbound flights that had previously been in Sector 3. Upon handoff acceptance, Sectors 1 and 3 transfer communications for their respective flights to Sector 4.
- The sector reconfiguration is complete when the change is activated in automation, and all flights are transferred to the appropriate sectors under the new airspace configuration.

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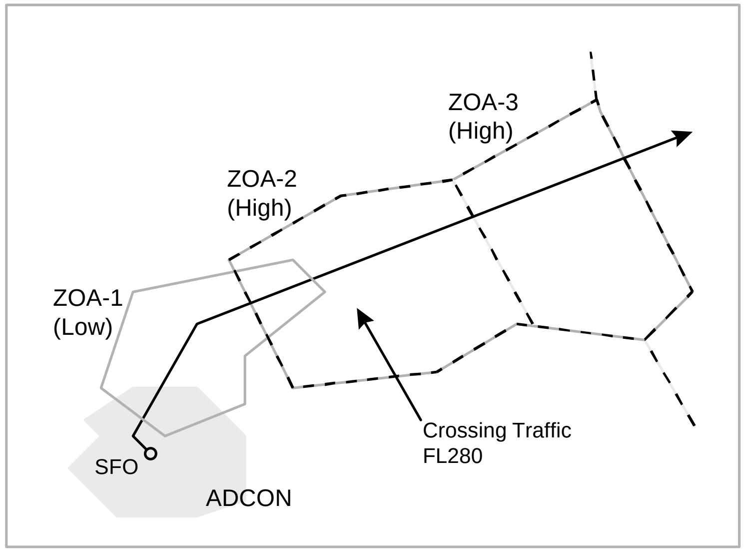
Scenario 4 — FREE FLIGHT AND SELF-SEPARATION WITHIN A DEPARTURE FLOW



AOCs for the major carriers contact the ATCSCC to request Free Flight and self separation for their San Francisco departures bound for northeastern hubs (i.e., JFK, LGA, EWR). The ATCSCC determines that these flights will operate on the best-wind route through seven En Route facilities (e.g., ZOA, ZLC, ZDV, ZMP, ZAU, ZDB, and ZNY). In a teleconference with the TMUs at these facilities, airspace configurations are devised to facilitate the AOCs' request, and the TMCs agree to accommodate the request to the extent possible. All flights receive the best-wind route clearance prior to departure, and detailed step-climb requests are received by the NAS from the AOCs for all flights.

- At the ZOA TMU, dynamic density and workload predictions indicate heavy traffic in ADCON and low-altitude En Route airspace at the time of the departure rush. The ZOA TMC therefore determines that Free Flight and self separation is not feasible until the traffic flow enters ZOA-2, the first high altitude sector. The TMC coordinates with the affected high altitude Area Coordinators to effectuate the airspace configuration required to accommodate the departure flow. The airspace reconfiguration is completed 20 minutes prior to the beginning of the high-altitude departure rush. *(Reference Scenario 3 for an airspace reconfiguration initiated by Area Coordinators. The reconfiguration in this current Scenario is initiated by the TMC, but the process involved in the reconfiguration is similar to that described in Scenario 3.)*

- As the departure rush approaches ZOA high altitude, ZOA-1 places some flights in-trail and speed-controls them. Other flights are allowed to run, but receive numerous altitude clearances to maintain vertical separation with higher traffic within the flow.

- ZOA-2 requests and receives (from ZOA-1)control on handoff for all flights. The ZOA-2 controllers observe the individual flight data objects to determine the flights that are CDTI-equipped, and the current step-climb request for all flights.

- As communications are established with flights in the traffic flow, ZOA-2 issues the highest feasible altitude to non-CDTI-equipped flights with regard to their current step-climb request. The controller then advises each CDTI-equipped flight of their traffic, and issues each of them a clearance to 1) operate within a specified distance of their cleared route, 2) discontinue speed control, if applicable, 3) maintain either vertical or lateral separation from their traffic, and 4) climb to their currently requested step-climb altitude.

- As the traffic situation develops, non-CDTI-equipped flights are separated in the traditional manner using speed control, interim altitudes, and vectoring. Any control actions on these flights that affect a CDTI-equipped flight are communicated to the applicable CDTI-equipped flight(s). Based on this information, CDTI-equipped flights may match speeds with leading traffic for stationkeeping, overtake leading traffic while maintaining vertical separation, or maneuver laterally to overtake leading traffic while climbing through or operating at that traffic's altitude. As each flight (either CDTI or non-CDTI) is able to reach a higher step in its altitude profile, an appropriate altitude request is automatically presented to the controller, who then issues the clearance as soon as traffic permits.

- Pilot-intent information such as self-assigned speeds, headings to acquire or maintain lateral separation, self-assigned interim altitudes, etc., are datalinked to the NAS and incorporated into the system's trajectory modeling for conflict detection.

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- Midway through the rush, ZOA-2 receives a northbound flight at FL280. Automatic conflict detection indicates that this flight conflicts with one non-CDTI and two CDTI-equipped flights in the departure flow. One of the resolution options indicates that a minor vector of the northbound flight will separate it from the non-CDTI-equipped flight, and that vector is issued. The two CDTI-equipped flights are below the crossing traffic, and currently cleared to climb through its altitude. The controller queries one of these flights, currently climbing out of FL260, if it can be out of FL290 within five minutes. Receiving an affirmative response, the controller leaves the flight's current self-separation clearance intact, with the additional requirement to climb through FL290 within five minutes. For the other CDTI-equipped flight, currently climbing out of FL250, the controller amends its clearance to maintain FL270. A short time later, the CDTI-equipped flight reports having position data on the crossing traffic, and the controller reinstates the flight's self-separation clearance. Immediately upon acquiring lateral separation, the CDTI-equipped flight resumes its climb.
- Upon handoff to ZOA-3, all relevant information for each flight is electronically forwarded via the flights' data objects on the situation display and the IFID. This information includes Free Flight route deviation values, self-separation indicators, step-climb request data, and pilot-intent information.

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Scenario 5 — SELF-SEPARATION IN LOW VISIBILITY APPROACH CONDITIONS

Weather conditions at ABC are marginal VFR, with a low overcast and 2 miles visibility. The ADCON supervisor decides to apply CDTI-based separation for suitably equipped aircraft on approach to ABC's closely spaced parallel runways, 24L and 24R. This improves airport capacity in the low-visibility conditions and effectively transfers separation responsibility to the cockpit for CDTI-equipped aircraft.

- To implement CDTI-based separation, the supervisor informs all approach controllers and the ABC tower controllers that CDTI separation techniques can be used for properly-equipped flights.
- The approach controller aligns the aircraft in parallel streams to the two runways, primarily in accordance with TFM DSS advisories. Two B-757s are approaching the initial approach fix for each runway. One of these flights is followed by a B-737, and the other is followed by an Aerostar 600. All aircraft are spaced according to aircraft type and approach speed, to provide time-based separation on the final approach courses.
- Information on the CDTI capabilities of each aircraft is displayed on the data objects of each flight. This information includes 1) an indication that the aircraft is CDTI-equipped, 2) confirmation that CDTI is active and 3) confirmation that the aircraft is providing identification, position, and intent reports. Noting that the data objects of the 757s indicate that they are CDTI-equipped and active, the controller verbally clears each aircraft for a CDTI approach to ABC, and instructs them to contact the tower when they are eight miles from the field.
- The clearance is not complete until each crew confirms by voice that they are willing to accept the clearance and that they have positive CDTI contact on the other aircraft. In this instance, each crew accepts the clearance and confirms that they have positively identified the other aircraft on the CDTI. The controller then aligns them abreast on parallel courses to runways 24L and 24R.
- The approach controller's attention is then drawn to the B-737 and the Aerostar. Flight information indicates that the Aerostar is not CDTI-equipped. Since both aircraft in parallel arrival streams must be CDTI-equipped to apply CDTI separation, the controller does not issue self-separation to either aircraft, instead providing standard spacing on approach.
- The tower controllers note from their flight information that each of the B-757s is maintaining CDTI separation. As they reach eight miles from the field, each aircraft makes initial data link contact indicating their intent to land at ABC on their assigned runway. If the messages from the two aircraft are inconsistent with their approach course or indicate that they intend to land on the same runway, tower automation generates an alert. In this case, the messages are consistent, and the tower controller issues a data link message to each aircraft acknowledging their intent and clearing them to land.
- After receiving a data link acknowledgment from each aircraft, the controller's attention turns to the next set of aircraft, the B-737 and the Aerostar.
- The Aerostar is not datalinked equipped, and it makes its initial call when it is eight miles out. The controller issues a verbal clearance to land on 24L. The B-737, which is datalink-equipped, checks in via datalink and is issued a datalink clearance to land.

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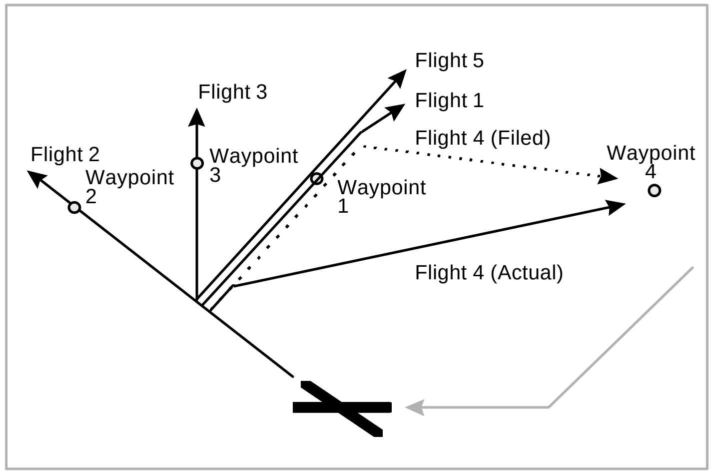
Scenario 6 — ADCON DEPARTURE RUSH



Within a short time span, five flight profiles are activated in the NAS as four flights push back from the ramp, and one flight is released to push back three minutes later. Upon activation, flight information is distributed to the IFIDs of the appropriate tower, ADCON, and En Route sectors/positions. The activation of these flights triggers taxi modeling, and the resulting estimated departure times are used for 1) conflict probing in ADCON and En Route airspace, 2) TFM DSS traffic load modeling in ADCON airspace, 3) dynamic density and workload predictions in En Route airspace, and 4) reserving departure slots in the traffic flow.

- At the ADCON departure sector, the controller observes that the departure sequence of the first four flights will serve to stagger their departure paths over different waypoints, allowing minimal runway spacing. It is also apparent that the fourth and fifth flights depart over the same waypoint, necessitating the push back delay on the fifth flight.
- Utilizing the trial planning function, the controller tests the feasibility of routing the fourth flight to its departure waypoint immediately after take-off. The system's response to the trial plan indicates that no arrival flights conflict with the departure on that path.
- Using the applicable system-generated input selection option displayed on the IFID, the controller enters the trial planned routing as a preplanned action. Then, using the APREQ function, the controller forces the output of the preplanned action on the tower controller's display.
- This information is displayed on the data objects for the flight on the tower controller's IFID, and the tower controller understands that the departure controller is working to relieve the push back restriction on the fifth flight.
- A short time later, the ADCON controller's information displays indicate that the tower has issued the new route/heading to the fourth flight, and that the fifth flight's push back restriction has been deleted.
- As each flight departs, the data objects for that flight on the departure sector's IFID indicate that the take-off role has begun, and the system automatically acquires the track.
- Immediately after take off, the tower datalinks a frequency change instruction for the flight to monitor the departure sector frequency, and datalink messaging capability is transferred.
- After observing the tracked target in proximity to the runway, and upon receipt of the initial datalink message, the departure controller uplinks a message informing the flight that it is in radar contact.
- The track for each flight automatically enters handoff status to the appropriate En Route sector. Timing indicators will alert the controllers at the ADCON and En Route sectors if a flight in handoff status approaches the sector boundary.
- Upon handoff acceptance by the En Route sector, the ADCON controller uplinks a frequency change message instructing the flight to contact the En Route sector.

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Scenario 7 — ADCON COMMUNICATIONS FAILURE (DATA AND VOICE)

At the En Route facility: Sector 1 in Area A is a low altitude En Route sector working arrival traffic into the ADCON. XYZ1234 has been handed off to the ADCON. Shortly after the transfer of communications, XYZ1234 returns to Sector 1's frequency to report that the ADCON did not respond to the initial call. As the controller attempts to raise the ADCON sector via landline, the handoffs on three other aircraft in handoff status go into "Fail" mode.

- When the ADCON sector does not respond to the interphone call, the Sector 1 controller calls the Area Coordinator to hold all arrivals in high altitude. Sector 1 then climbs XYZ1234 out of ADCON airspace and issues holding to that flight, and to all other arrivals that are already working Sector 1.
- Sector 2 in Area B is a low altitude En Route departure sector that has received departure messages on four flights. Sector 2 observes the limited data blocks of four flights approaching the sector boundary, but receives no handoffs from the ADCON. One of these flights comes on Sector 2's frequency to report that it was unable to contact the ADCON. The controller radar identifies the flight.
- The tower contacts Sector 2 to report that three flights were unable to contact the ADCON and have returned to the tower frequency. The tower asks if the other flight contacted Sector 2. The Sector 2 controller confirms that it did, requests the tower to transfer the other flights, and to shut off the departures. The controller radar identifies the flights when they come on frequency.
- At the same time, the OCC receives NWIS/NIMS information that all voice and data communications at the ADCON have failed, and an Event Ticket has been issued. The OCC teleconferences with the TMC and all of the Operational Supervisors and Area Coordinators whose airspace abuts the ADCON. With no information concerning the nature of the failure, it is collaboratively decided to sterilize ADCON airspace until it can be verified that the failure does not extend to navigational components of the NAS infrastructure. The OCC initiates a status assessment to verify the operation of all terminal infrastructure components.
- The TMC coordinates via teleconference with all tower supervisors within ADCON airspace to place a ground stop on all departures. The TMC verifies through flight object information that 1) all recent arrivals except XYZ1234 are on their respective tower frequencies, 2) XYZ1234 is holding in En Route airspace, and 3) Sector 2 is working the last of the departures.
- The OCC determines that the failure is isolated to the ADCON facility, and that all other NAS infrastructure components are operational.

At the ADCON: Five minutes after the initial indication of a problem, communications with the En Route TMU is established via the ADCON supervisor's cellular telephone. The ADCON supervisor reports that the ADCON was struck by lightning, and all voice and data circuits are disabled.

- ADCON AF reports that the main junction box (telco) suffered major damage. The ASR-9 and two of the three communications (RTR) sites go through the telco panel, and are therefore out of service. The remaining RTR site is on the airport and used by the tower for ground control and departure. AF will attempt to reconfigure additional emergency transceivers for use by the ADCON. However, the coverage of these transceivers does not extend to the ADCON/En-Route boundary. Estimated time to repair the telco problem is six hours. The workforce at the NWIS/NIMS has not yet been informed.
- The En Route TMC gains the approval of the ADCON supervisor to take over the ADCON airspace that will lack radio coverage, and coordinates as required with the appropriate En Route supervisors, area coordinators, and controllers, to resume limited airport operations.
- After ½ hour, AF maintenance at the ADCON reestablishes administrative telephone service, reports to the OCC, and re-establishes the SOC interface with the OCC.

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- After four hours and fifteen minutes the NWIS reports that all communication services have been restored. The Event ticket is terminated. The repairs are temporary and will require further effort by AF maintenance and telco personnel to restore full redundancy to the data/voice communication system.
- The OCC is informed via the SOC that the estimated time to return to normal status is twenty four hours. A new Event ticket is issued stating loss of redundancy at the ADCON. This Event ticket will remain until normal service is restored.

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Scenario 8 — TERMINAL RADAR/BEACON FAILURE

Sector 25 is a low altitude ECON sector. Primary Radar/Beacon for Sector 25 is the QHH Long Range Radar (LRR), which is unstaffed between 2200 and 0600 local. Sector 25's backup for the QHH LRR is the XYZ Radar/Beacon, which is maintained by the XYZ ADCON facility. Like the QHH LRR, this facility is unstaffed between 2200 and 0600.

At 0000 local a thunderstorm in the vicinity of XYZ causes a power fluctuation at the XYZ Radar/Beacon facility, and the site automatically shuts down. The shutdown is noted at the ECON facility but no action is taken since the site is backup and can wait until morning for restoration. However, at 0300 hours the ECON facility loses all data from QHH LRR, and Sector 25 has a complete loss of Radar/Beacon data from both its primary and backup sites.

IN TODAYS ENVIRONMENT: Remote restoration efforts by the MCC at the ECON facility fail to restore QHH LRR.

- Two technicians (one telco, one Radar) are dispatched to QHH to diagnose and resolve the problem. Estimated travel time is 1 hour 30 minutes.
- A technician is dispatched to XYZ Radar with an estimated travel time of 30 minutes.
- Sector 25 remains without data until restoration of at least one of the sites. The time to restore the sites is dependent on the technicians' travel, diagnostics, and repair times.

IN 2005: The NAS Infrastructure Management System (NIMS) remotely monitors *and* controls all Radar sites within the area of interest.

- The system automatically determines the XYZ Radar shutdown is due to an over-voltage that no longer exists, and the SOC technician restarts XYZ Radar immediately after detecting its failure at 0000 hours.
- At 0300 the system automatically determines that the QHH LRR problem is due to telco equipment, and the appropriate technician is dispatched, with an estimated travel time of 30 minutes
- Sector 25 suffers no loss of data. It loses redundancy momentarily at 0000, during the immediate restoration of XYA Radar. It again loses redundancy at 0300 when QHH LRR fails. However, with diagnostics completed immediately after the problem is detected, the time to restore is reduced to the technician's travel and repair time.

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Scenario 9 — SCHEDULED SHUTDOWN OF LRR SERVING THREE ECON FACILITIES.

QHH Long Range Radar (LRR) serves three ECON facilities, ECON-1, ECON-2, and ECON-3. This LRR requires that a shutdown be scheduled to replace the rotary joint in the antenna system. The rotary joint is currently in tolerance, but it causing noise problems.

IN TODAY'S ENVIRONMENT: The MCC Technician at ECON-1 reviews the latest published schedules issued by Facilities 2 and 3. The technician finds the earliest available period for QHH LRR shutdown that will allow the maximum coverage redundancy by the QHG and QED LRRs, which are the sites adjacent to QHH.

- The ECON-1 MCC technician first calls the MCC technician at ECON-2, and learns that the desired period is unavailable because the LRR on the other side of QHG is down for special maintenance at that time. The ECON-2 MCC does not want the LRRs on both sides of QHG LRR down at the same time, since there would be no redundancy for QHG. Therefore the MCC technicians negotiate a later time for shutdown of QHH LRR.
- The ECON-1 MCC technician then calls the MCC technician at ECON-3, and learns that the time just negotiated is not available because of similar problem with QED LRR.
- With all the technicians on conference call, a time is negotiated for shutdown of QHH LRR.
- The MCC informs the Work Center (WC) of the negotiated shutdown time.

IN 2005: The SOC Technician at ECON-1 calls up a screen that shows all the scheduled shutdowns for all LRRs within the area of interest.

- The technician inserts a desired shutdown time for QHH LRR with a priority code.
- This system shows the priority of all shutdowns and allows a higher priority to override.
- If the desired time is rejected the earliest available times are displayed as options from which the technician can select.
- Once selected, the scheduled shutdown is shown on all surrounding SOCs and WCs.
- The concerned WC can immediately inform the work force of the agreed shutdown time.

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